ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

Nos. 76–77.] APRIL AND MAY. [1893.

CCXCVIII.—AMERICAN GINSENG.

(*Aralia quinquefolia*, A. Gray.)

WITH PLATE.

In a recent number of the *Kew Bulletin* (1892, p. 107) a note was published on Ginseng, a tonic and stimulant medicine highly valued by the Chinese. It was pointed out that there were two principal sorts of Ginseng known—the North American Ginseng (*Aralia quinquefolia*, A. Gray), collected in the Eastern United States and Canada and exported to China, and the Corean Ginseng (*Aralia quinquefolia* var. *Ginseng*, Reg. et Mack), a principal article of export from Corea into China. The produce of the American plant is used only as a substitute for the Chinese article. It is ranked as about fourth in quality; that from Japan being the least esteemed.

Seeds of the Corean Ginseng were recently received at Kew from Mr. Walter C. Hillier, Her Majesty's Consul General in Corea. It is, however, too early, yet, to give the results. In the meantime, the following information may prove of interest in regard to the American plant, which is proposed to be protected from extinction in Canada by legislative enactment, while in the United States experiments are being carried on to increase the supply by cultivation. The industry, such as it is in the New World, has, hitherto, been entirely dependent on the plants found wild in the forests.

The American Ginseng belongs to the natural order *Araliaceæ*, an order closely allied to the *Umbelliferæ*. Amongst *Araliaceæ* are included plants of very different habits and characters, such as *Panax*, *Fatsia*, the tropical *Sciadophyllum* and *Hedera* (the common ivy). *Aralia quinquefolia*, A. Gray, has a low herbaceous stem seldom more than a foot or 15 inches high, the leaves are longstalked, palmatisect, with usually five leaflets (hence the specific name), arranged in a whorl of three or four at the summit of the stem, the leaflets have generally three larger than the others, they are somewhat thin, obovate-oblong, pointed and serrate. A single umbel of flowers appears on the short, slender, terminal peduncle with small yellowish flowers, the calyx is adherent to the ovary and surmounts it with five minute teeth, the corolla is made up of five small oval white petals which soon fade away, the stamens (when present) are five in number, with small heart-shaped anthers, and there are two, sometimes three, persistent ordinary curved styles.

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The ovaries expand into small round bright red berries about the size of small peas each with two seeds. The root (the part used) is tuberous, three or four inches long and usually branching into two or three tap-shaped divisions. It is wrinkled by parallel transverse ridges, and gives rise to a number of fibrous rootlets. The upper portions of the root-tuber show several angular scars, the remains of previous stems which die down annually. As the roots increase with age they often assume strange forms, and such roots are highly prized, the Chinese readily giving large sums for them.

In America the roots are not regarded as possessing active medicinal properties. They have, however, an aromatic bitter-sweet taste, are somewhat mucilaginous, and may have a mild, stimulant, tonic effect.

The spring shoots of Ginseng come out of the ground in New York State about the first of May. "The leaves attain their full "size in June. The blossoms appear about the first of July, and are "very small and delicate. The berries develop rapidly, and are light "green until the 20th August, when they commence to colour; in "September they are bright scarlet, and make a very showy appearance. "The berries are round, elongated, or somewhat triangular in shape, "according to the number in the cluster. They are often as large as a "small pea, and are pleasant to the taste. They fall to the ground "soon after ripening and are covered by the falling leaves."—(*Garden and Forest,* 1892, p. 223.)

An account of the Ginseng plant published by the Department of Agriculture, Canada,* gives the following information: "The plant "has a wide distribution, and is found usually in upland woods and "not in swamps or low-lying districts. It appears to thrive well in "localities where limestone abounds. It frequently occurs gregariously "in beds from which several pounds of roots may sometimes be gathered. "As cattle are fond of the leaves it soon becomes scarce in woods to "which they have ready access. . . . . It was first discovered in Canada, "near Montreal in 1716, by Father Lafitau, a Jesuit missionary among "the Iroquois, and in 1718 a description of it was furnished. The "French soon engaged in collecting and exporting it to China, and so "great did the trade become, that it gave quite an impulse to the "commerce of Montreal for a number of years. At one time great "numbers of Indians were engaged in gathering it about Montreal "and Quebec, and large quantities of it were sent to China. In "1832 the shipments of Ginseng from the United States amounted to "407,067 pounds, valued at $99,303. In one county in Wisconsin the "trade is reported to have reached, in 1858, $40,000, and in 1859, $80,000. "Immense quantities have been exported from Minnesota. At present "the chief sources of the plant in the States are Ohio, West Virginia, "and Minnesota. About the close of the eighteenth century it was "discovered also at Massachusetts, its exportation commenced and large "returns obtained. During the last year 75,000 pounds were sent from "America. . . . . "

"The quantity sent out of Canada last year [1890] is stated to "represent $100,000, and one retail druggist exported $1,600 worth. "From along the Kingston and Pembroke Railroad fully $20,000 "worth was shipped. The price realised was from $3 to $3·50 per "pound for dry roots. The question is now being considered whether "it would not pay to cultivate it."

* Ontario Agricultural College. Experiment Station. Bulletin LXV. Ginseng, Toronto, 1891.

In order to prevent the extermination of the Ginseng plant in Canada, the Legislative Assembly of the Province of Ontario has passed a Statute (54 Victoria, 1891) enacting that—

"Except for the purpose of clearing or bringing land into cultivation, no person shall, between the first day of January and the first day of September in any year, cut, root up, gather, or destroy the plant known by the name of ginseng, whenever such plant may be found growing in a wild or uncultivated state."

The penalty for contravening the provisions of this Act is "not less "than five dollars or more than twenty dollars together with the costs "of prosecution, and one-half of such penalty shall be paid to the "prosecutor."

The search for Ginseng roots appears to be as keenly followed in the United States as in Canada. No restrictions have, however, as yet been placed upon digging the wild roots, but it is evident that if the steps taken to cultivate the plant are unsuccessful, its occurrence in the United States in the wild state will become, before long, greatly reduced. Indeed, in an article published in *Garden and Forest*, 1892, p. 223, Mr. G. Stanton, states :—

"From Minnesota to Carolina the gathering [of Ginseng roots] has been carried on until, in the places where this beautiful plant was once so abundant that one could hardly step without treading on it, only single roots can now be found. It is only a question of time when Ginseng at the present rate of destruction will be utterly exterminated from our forests. Last year more of the root was exported to China from this country by 80,000 pounds than was ever sent before in any single year, and notwithstanding the growing scarcity there are 10 persons hunting for the roots now where there was one ten years ago."

Until quite recently there appears to have been a general opinion in America that Ginseng could not be successfully grown as a garden crop. The attempt, it is said, had been repeatedly made "by planting the roots and sowing the seed, but they never grew." Mr. G. Stanton, Summit Station, New York, who may be regarded as the pioneer of the movement to cultivate Ginseng, states :—"My first sowing of seed did not pro-"duce a plant; 200 roots which I put into the ground in 1886 made "little growth the first year, and the outlook was so unfavourable that "I almost abandoned the attempt. In 1887 I put in some roots and "sowed some seeds, and the next year my plants made a better showing. "I then commenced to study the habits and characteristics of the plant, "and with the experience gained my success has been complete. I "had thousands of fine plants growing in my ground in 1891 . . . in "my opinion the growing of the plant can be made profitable, even if "the root does not bring more than two dollars per pound." The price realised in Canada in 1890 for Ginseng, was from three dollars to three dollars 50 cents per pound for dry roots.

In August last the Marquess of Lorne forwarded to Kew an interesting letter received by him from the United States respecting the cultivation of Ginseng. The plant was not at the time in the Kew collections, but application was made for seed, which was received from Mr. Stanton, together with the following letter in regard to the treatment and the general cultivation of the plant:—

Summit Station, New York,
September 3rd, 1892.

In compliance with your request of the 20th August, I send you by mail one ounce (500) Ginseng seed, which I hope will reach you in good

condition, and that you may be successful in getting plants from them. You will please keep them in moist earth till they are planted, which should be done as soon as convenient; they must not be allowed to get dry. It takes Ginseng seed 18 months to germinate; planted this autumn, they should send up small 3-leaf plants in the spring of 1894. To obtain best results they should be sown in a bed in the forest, where they could be protected from stock or being trampled upon. A bed three feet wide and four feet long will be ample for one ounce of seed. Ginseng is found mostly in hard-wood forests, upon dry ground, where beech, maple, and basswood predominate.

In garden culture any light, loose, rich soil will meet the requirements, only it must be put in condition that will not bake. The plants must be kept shaded. Meet the natural requirements of the forest as nearly as possible. My methods are to form outlines of beds with boards six inches wide, held in position by stakes; beds three feet wide, any length desired. I sow in drills two to three inches apart, seed one inch apart in drill, put them in about one inch deep, then cover the bed with muck or leaf loam, or some kind of mulching, so as to keep the ground moist. I place brush upon the beds to protect them till the plants come up. When the roots are two or three years old they may be taken up and transplanted, four to six inches apart each way. I have not made much advancement as yet in cultivating from seed, as I have not been in the business long, but I have some fine plants second and first season from seed. In garden culture there is some loss of young plants from snails and insects; worms are also liable to injure the roots. I have placed in one corner of the package 25 last year's seeds, which should give you plants next spring; they were put into the ground one year ago. Those that I have examined look all right. Please examine the germ of one of these with magnifying glass, also one of the fresh seeds. Enclosed you will find four last year's seeds, dry, please examine them also. In package with seed are two fresh berries, one ripe and one green; also a stem from which the berries have been taken; also a stem with three small leaves.

I shall be pleased to hear from you at any time. Should you care to give this matter any further trial I can furnish you with roots next season, providing an order was sent early in August.

A very interesting article on Ginseng, by Nicholas Pike, appeared in the *Scientific American*, January 10, 1891; also by the writer in *Garden and Forest*, May 11, 1892. The Bulletin LXV., Ontario Agricultural College Experimental Station, Toronto, is also of interest.

G. Stanton.

Explanation of Plate.

American Ginseng (*Aralia quinquefolia*).

[Reproduced from Report of the Botanist, Department of Agriculture, U.S.A., 1884, pl. ix.]

1. Stem with three quinquefoliolate leaves.
2. Sub-globose umbel of flowers.
3. Cluster of berries.
4. Tuberous root branching into two divisions with numerous transverse ridges.

American Ginseng (*Aralia quinquefolia*).

CCXCIX.—Y-DZI OF TONQUIN.

(*Coix gigantea*, Roxb.)

In July 1881, there appeared in the *Bulletin de la Société d'Acclimatation* of France a note on the economic value of the Y-dzi, a plant native of Annan, French Cochin-China, and Tonquin. It was described as a grass closely allied to the common Job's tears (*Coix Lachryma*), but believed to be a new species. The name *Coix Ma-yu'en* was suggested for it. The stem was said to attain a height of between 6 and 7 feet. The fruits were smaller than those of the ordinary Job's tears, softer in texture, and not marked with the grey marbling found on the latter. The grains were believed to possess peculiar medicinal properties and to yield a valuable food, either parched, made into a refreshing beverage, or a nutritious soup. In a further note which appeared in the same *Bulletin* for December 1881, a chemical analysis of the grains of Y-dzi was given. There was nothing remarkable indicated in this, and, as will be shown later, it agrees very nearly with analyses of the grains of ordinary *Coix* made in this country. The prominence given to the merits of Y-dzi in France, led to inquiry being made at Kew respecting the advisability of introducing the plant to some of the British Colonies. The impression which the French account produced is very well shown in the following correspondence :—

Mr. E. J. Ackroyd to Royal Gardens, Kew.

29, Oriental Place, Brighton,
1st March 1889.

Dear Sir,

I beg to enclose an extract from a Hong Kong paper, *The Catholic Register*, respecting a shrub called the Y-dzi which is said to grow in Annan and Tonquin.

The article ascribes various valuable properties to this shrub, and I should be much obliged if you would kindly let me know whether it is known at Kew.

Seeing that it could be substituted for the *Eucalyptus*, I was thinking (if that is really the case) of getting some seeds and sending them to Mauritius, where they would prove invaluable if they really destroy miasma.

I hope to return to Hong Kong in October, and, should your report be favourable, I think, through the Rev. Père Limonier, Head of the French Mission, I could obtain some of the seeds. I am spending only a few days here, my permanent address is St. George's Club, Hanover Square, London.

I remain, &c.
(Signed) Edw. J. Ackroyd,
Registrar, Supreme Court,
Hong Kong.

P.S.—If you think it would be worth while, I would bring the matter to the notice of the Government in Hong Kong, and if I obtained some of the seeds I would ask that the plant be cultivated in the Government Botanic Gardens there. I believe I have, through Père Limonier and other persons connected with Tonquin whom I know, facilities of obtaining seeds.

[Extract.]

Our missionaries at Tonquin have sent to the Congregation of Propaganda, in Rome, some seeds of the Y-dzi. This shrub grows six feet and a half high, and could, with far greater advantage, be substituted for the *Eucalyptus*. The Y-dzi is indigenous to Annan, but it is found all over Cochin China and Tonquin. It is also called *bobo* in the Annanite dialect.

The grains of the Y-dzi, stripped of their husk, are eatable like common grains, and possess a peculiar aromatic taste. The Y-dzi is not only a nutritive, but a medicine plant. The inhabitants of Tonquin call it "the grass of life and health," because it destroys the miasma, and purifies unwholesome water. The mountainous regions of Tonquin are extremely unhealthy, especially those lying between Bac Ninh and the Chinese province of Quang Oi. Besides the air, the water of the rivers, which is used there for drinking, is unwholesome as that of wells. Travellers use the Y-dzi in the same manner as tea is used in China. The grains of the Y-dzi, eaten in certain quantities, have been found an efficacious cure of disease of the liver caused by the bad effect of the tropical climate. "The grains of the Y-dzi," writes a missionary of Tonquin, "have excellent properties. They afford a refreshing "beverage which purifies the blood, invigorates the stomach, and is "diuretic. To obtain it they take off the husk, extract the almonds, "and boil them in water. Well-to-do people in Tonking make very "frequent use of the Y-dzi during the summer. Here the plant easily "grows six feet and a half high, and produces a good quantity of "grains. It is sown near pools, marshes, and around gardens, in waste "ground, &c."

Mr. E. J. Ackroyd to Royal Gardens, Kew.

Kensington Palace Hotel,
7th September 1892.

Dear Sir,

In November or December, 1888, I wrote to you about a tree or shrub in Tonquin called the Y-dzi, said to possess valuable properties for drying up marshy or malarial land, and other purposes.

In reference to this subject I am now able to send you some seeds of this plant, which I have to-day received from the head of the R.C. Mission in Hong Kong. He sends seeds and an extract from a letter written by one of the Missionaries in Tonquin, which says :—

"J'ai trouvé la plante en question, et je vous envoie des graines. Cette plante qui ressemble au Larme de Job demande à être planté dans un terrain frais et près d'un étang, d'une mare. C'est surtout comme refaisant les forces que la graine pilée est prise—on en fait des protages généreux—prise sèche elle garantit de la fièvre dit on."

I am going out to Hong Kong at the end of October, any letters addressed to Mr. Justice Ackroyd, Supreme Court, will always find me. Should you have any news to give me about the seeds or the plant before I leave I will be glad to hear from you, the seeds seem to me to be very dry, do you think there is any use sending some of them to Mauritius ?

Believe me, &c.
(Signed) Edw. J. Ackroyd.

The Director,
Royal Gardens, Kew.

The specimens of seeds of the Y-dzi forwarded by Mr. Justice Ackroyd were duly received at Kew. It was evident that they were derived from a species of *Coix*, and they very closely resembled those of *Coix gigantea*, Roxb., *Fl. Ind.* iii., p. 570. This plant is fully discussed in the *Kew Bulletin*, 1888, pp. 266–268. It is needless to say it is not a shrub, and it possesses no merits for counteracting the malarial influences of marshy localities beyond that possessed by any coarse, quick-growing vegetation necessarily absorbing a large quantity of water. The species of Coix are well-known tropical grasses, found in damp and marshy places. The best known is *Coix Lachryma*, and this is widely distributed in both hemispheres. In many countries it is regarded as a troublesome weed, and a source of annoyance, especially in rice fields. The drop-like fruits known as Job's Tears are used for necklaces and in various ways as articles of ornamentation. The usual colour is white, but they are sometimes found slightly tinged with pink, and sometimes grey or almost black. An account of *Coix Lachryma* var. *stenocarpa* with long cylindrical involucres, used by the Karens (a semi-aboriginal tribe inhabiting certain districts of Lower Burma) for ornamenting their dresses, is given in the *Kew Bulletin*, 1888, p. 144 (with plate).

The peculiar medicinal and nutritive properties attributed to the Y-dzi plant in Tonquin and Cochin China have not been associated before with any species of Coix. The results of chemical analysis of the grains after the removal of the involucre, show only a slight increase in the amount of oil or fat present in the great majority of cereals.

A comparison of the analysis of Y-dzi grains given in the *Bulletin de la Société d'Acclimatation*, December 1881, with that given of *Coix gigantea* in the *Kew Bulletin*, 1888, p. 267, leaves little doubt of the practical identity of their chemical composition, and, for the present, we may assume that the Y-dzi is only a form of the Indian *Coix gigantea*, Roxb., yielding a grain (a kind of pearl barley), long known to yield "an excellent diet drink for hospital patients in China" [Dr. Smith, quoted in "A Classified and Descriptive Catalogue of the Indian Department," *Vienna Exhibition*, 1873, p. 59].

CCC.—MANILA ALOE FIBRE.

(*Agave vivipara*, L.)

This is the commercial name given to a fibre exported from Manila in moderate quantities, but quite distinct in its character and origin from the Manila hemp of commerce. This latter is, as is well known, obtained from a wild banana of the Philippines *Musa textilis* (*Kew Bulletin*, 1887, April, p. 1). The origin of the Aloe fibre was apparently unknown. It was, however, regularly met with in commerce, although the price realised for it was always much below that paid for various sorts of Manila hemp.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew,
October 8, 1890.

SIR,

I AM desired by Mr. Thiselton-Dyer to inform you that a sample of "Manila Aloe Fibre" has recently been presented to the Museums of Economic Botany at Kew, and a portion of this sample is enclosed

herewith. This Aloe fibre comes regularly into the London market, and is quoted as worth about 14*l.* to 16*l.* per ton.

2. The plant yielding this fibre does not appear to be known in this country. It is evidently quite distinct from *Musa textilis*, yielding ordinary Manila hemp. Probably it is a species of *Agave*, closely allied to that yielding the Sisal hemp of commerce.

3. In order to determine the plant exactly, Mr. Thiselton-Dyer would be glad if the Secretary of State would approve of a reference being made on the subject to Her Majesty's Consul at Manila, with a request that one or two moderately large leaves of the plant be forwarded in a dry box to this establishment. In the case of Agave leaves, it may be mentioned that they travel very well if packed in a perfectly dry state without soil or any other material. If the box is pierced with holes to afford ventilation all the better. It would add to the interest of the specimens if the Consul could add a few words in regard to the methods employed in preparing the fibre.

I have, &c.
(Signed) D. Morris.

Sir Villiers Lister, K.C.M.G.,
Foreign Office.

Foreign Office to Royal Gardens, Kew.

Sir, Foreign Office, July 7, 1891.

With reference to your letter of the 8th of October last, I am directed by the Marquis of Salisbury to request you to inform Mr. Thiselton-Dyer that Her Majesty's Consul at Manila reports that he has forwarded to Kew Gardens, under the charge of Captain Wilson, of the s.s. "Barden Tower," a small box containing a few leaves of the Manila Aloe plant (Maguay).

I am, &c.
(Signed) James Ferguson.

The Assistant Director,
Royal Gardens, Kew.

Mr. Consul Gollan to Royal Gardens, Kew.

British Consulate, Manila,
May 20, 1891.

Sir,

I beg to inform you that under directions from the Foreign Office I, this day, forward to you a small box containing four leaves of the Manila Aloe (Maguay), which I trust may arrive in good condition and answer the purpose you have in view. I enclose a few notes from Mr. Osmond, a gentleman who is a considerable expert in such matters, as to the preparation of the fibre.

I send, in the same box, a small specimen of rope of great strength and durability made from another fibre called "Cabo Negro."*

I am, &c.
(Signed) Alex. Gollan,
Her Majesty's Consul.

W. T. Thiselton-Dyer, Esq., C.M.G., F.R.S.,
Director, Royal Gardens, Kew.

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* The fibre sent as "Cabo Negro" was the produce of the sugar palm of the East Indies, *Arenga saccharifera*.

(Enclosure.)

PREPARATION OF MAGUAY FIBRE.

The leaf is first soaked in water until it becomes quite soft and pulpy, which takes place in about a fortnight. It is then drawn between the thumb and fingers which easily presses off the pulp, leaving a clean fibre. This is afterwards dried in the sun.

If required for immediate use, the leaf is first pared down on each of its flat sides, and afterwards drawn between two pieces of cane lightly pressed together, nothing but the fibres passing through. But this method is a very wasteful one, as many fibres are broken.

Amongst the many uses to which maguay is applied may be mentioned that of violin strings, for which it is much appreciated by the natives.

Manila, May 1891. (Signed) J. H. OSMOND.

The specimens kindly obtained for Kew through the good offices of Mr. Alexander Gollan, Her Majesty's Consul at Manila, were received in good order. They consisted of fresh leaves of an *Agave* in different stages of growth, and there was little difficulty in recognising them as belonging to *Agave vivipara*, L. (A. Cantala, *Roxb.*), the plant which (according to *Kew Bulletin*, 1890, p. 50) yields also Bombay Aloe fibre. The distribution of this plant so far eastward as the Philippine Islands does not appear to have been specially noticed before. It is originally an American plant, and it owes its spread in India, at least, to its use as a hedge plant to keep back cattle. The local name *Maguay*, given to it at Manila, is a generic term applied by Spanish-speaking people to numerous species of Agaves. For instance, in the south of Europe it is often applied to *Agave americana*, although this plant in South America is distinguished as *Maguay de cocuyza*. In some parts of Mexico *Agave vivipara* is known as *Theo-metl*.

The method of preparing the fibre at Manila, described by Mr. Osmond, is very crude, and the result is necessarily unsatisfactory. The process of maceration is not at all well adapted for extracting the fibres from leaves of monocotyledonous plants. The fibres are discoloured by long immersion in water, and during the process of fermentation, extending over a fortnight, the strength of the ultimate fibres is greatly weakened. It may, therefore, be readily understood the value of Manila Aloe fibre is comparatively small, and it can only be profitable to produce it when the price of white-rope fibres is exceptionally high. In the last *Monthly Circular* (dated the 16th March 1893), issued by Messrs. Ide and Christie, of Mark Lane, Manila Aloe Fibre is dismissed with a few words,—"nothing doing, 17*s*." [per cwt.]. In the same circular Bombay Aloe Fibre is described as "dull at 8*s*. to 13*s*." [per cwt.].

CCCI.—BOTANICAL ENTERPRISE IN 1796.

As an interesting instance of the efforts made nearly 100 years ago to improve the circumstances of our Colonial Possessions, it may not be inappropriate to draw attention, in the pages of the *Kew Bulletin*, to a document which treats of the introduction of the clove

tree to the island of Dominica and of the reception in this country of probably the first sample of cured cloves that was grown in any British colony in the New World. The publication of this document, at the suggestion of Sir Joseph Banks, with the view of serving as an expeditious mode of communicating information on economic products and plants to distant parts of the Empire almost exactly anticipated the object for which the *Kew Bulletin* was started six years ago. What may very suitably be looked upon as the *Bulletin* of 1796 is entitled "A Narrative of the successful manner of cultivating the Clove Tree "in the Island of Dominica, in the Windward Carribbee Islands. "By William Urban Buée, Esquire. London: Printed in the year "1797." It appears that M. Buée, a Frenchman settled for many years at Dominica, had successfully introduced clove plants from Cayenne to the former island in 1789. Afterwards, in 1791, he bought more trees, 14 in number, from a gardener from Cayenne, whom he met at Martinique. Afterwards these were increased by 1,500 trees raised from seed obtained direct from Cayenne in 1793. The clove trees planted in 1789 "appeared with clove buds on or about the "20th January 1795; some of the cloves were fit to be gathered in "May and June following; and such of the cloves as were left on the "trees for the purpose of obtaining the mother of cloves for seeds "acquired a proper degree of maturity in July and August; so that, "allowing those two trees to be about one year old when they came to "me from the seeds, I think the clove tree becomes productive in the "course of little more than six years."

The close relationship of the clove and the indigenous pimento tree (both belonging to the natural order *Myrtaceæ*) was readily noticed by our author, who deduced the inference that where one flourished the other would also be likely to grow.

Several experiments were undertaken to test the best kind of soils suited for clove cultivation. In one instance the author states, "since "the planting of the last 14 trees it is with satisfaction I can assert "that the four trees planted in clay have grown with at least as "much, if not more, luxuriance than the other ten." Further, "a "pasture ground, formerly in coffee, of a compact, strong, gravelly "soil, with some parts of a clayey nature," was next tried. The result proved that "the trees grew well in both." He concludes, "These [and "other] observations, I hope, will be sufficient to show the nature of the "ground which is fittest for the clove tree, and to prove clearly that it "does not require a rich soil or a loose one; but, on the contrary, will "thrive best in a strong, compact soil, whether of a gravelly or clayey "nature." It will be remembered that in the account of the clove industry at Zanzibar given in *Kew Bulletin* for January last, p. 17, it is stated that the best soil for cloves in that island and Pemba is also clayey. In Dominica our author anticipated that the only drawback to clove cultivation (especially in the district of La Soye, where the soil was suited for little else) was violent winds, as the settlers in that quarter, he says, "had unfortunately and very imprudently cut down all "the woods along the seaside, a thick hedge of which they ought to "have left standing, to prevent the wind from shaking and the sea air "from parching their plants. To remedy this hedges of *poïds doux* "[Inga laurina] may be planted at short distances, particularly towards "the seaside and on elevated grounds facing the east."

As regards yield, Mr. Buée states: "The two trees that have pro-"duced cloves this year, on the Montpellier estate have netted me four "pounds and a half of cured cloves, besides two pounds at least of "cloves which I have left on the trees to obtain mother of cloves, for

" the multiplication of that spice ; and besides this I have about half a " pound of cloves, which having fallen on the ground before their " degree of maturity, have been dried and are very good for domestic " use; these last are strong but small, so that these two [young] trees " have produced more than seven pounds of cloves." The author then proceeds to describe with great minuteness the manner of " planting and rearing the clove tree from the mother clove." In transplanting for the nursery beds a very ingenious transplanting machine was used, consisting of a tube made of sheet iron with hinges at the side and furnished with two handles at the top. The manner of using this machine was as follows : " Take the planting machine, shut the hinge, lay it over the " plant, taking care the latter is in the centre ; push the machine down " as far as it can go—the deeper the better; then with a flat trowel dig " into the earth till you have reached the bottom of the planting " machine, and holding it (with the seedling in it), with the left hand " and raising it with the trowel in the right hand, take up the plant and " carry it to the place of its destination." This transplanting machine of one hundred years ago is almost identical with the new and patented machines in use in Ceylon and elsewhere at the present time. M. Buée cured the produce of his clove trees and forwarded a sample to this country in order to obtain the opinion of experts upon the produce. The sample appears to have been forwarded to the Right Hon. Sir Joseph Banks, the President of the Royal Society, to whom later M. Buée's manuscript was also referred by the Earl of Liverpool, afterwards a Secretary of State for the Colonial and War Department. A copy of Sir Joseph Banks's reply is reproduced below. It is an interesting document. It clearly points the way to the policy in regard to botanical enterprise in the colonies which Parliament has committed to the Royal Gardens at Kew, and which has been consistently followed during the last fifty years. It may be added that M. Buée's report was published in this country as recommended by Sir Joseph Banks, and it was illustrated by an excellent double-quarto plate of the clove plant with buds, flowers, and fruit, and a drawing of the transplanting machine.

Sir Joseph Banks to the Earl of Liverpool.

My Lord, Soho Square, Angust 11, 1796.

I beg leave to acquaint your Lordship that I have read with attention the paper on the successful culture of the clove tree in Dominica, which your Lordship did me the honour of referring to me, and am of opinion that it ought to be printed for the information of His Majesty's subjects in the West Indies and other intertropical colonies.

Mr. Buée is, as far as I know, the first person who has observed that the pimento tree prospers best in those sterile soils where trees whose wood is of a hard texture abound, and that sugar cannot be cultivated to advantage in such places; also on the other hand, that where trees, whose wood is soft, are naturally found, pimento trees are rarely met with, and sugar plantations will succeed; on such sterile soils he has tried clove trees, and found them congenial to its nature.

These observations open to the cultivators of hot climates a new source of wealth, which will not probably be confined to the growth of cloves; other spices may also prosper best in the barren soils of the West Indies, as lavender, thyme, and other aromatic plants are known to do in those of Europe.

I have the honour of sending to your Lordship, with this, a paper containing samples of cloves received by me from Mr. Buée some months

ago. Nos. 1 and 2, mentioned by him p. 19, are mixed; No. 3, his best sort, are separate. Your Lordship may, if you think fit, order a comparison to be made, by some dealers in spice, between these and the cloves we usually receive from the Dutch. I shall only add that when I applied for information on the same subject to an eminent wholesale dealer in that article, the only answer I obtained was that he thought me grievously deceived in supposing the cloves to be the produce of the West Indies, he being absolutely certain they came from the East.

In case your Lordship should think fit to order any explanatory matter to be added to Mr. Buée's dissertation, I enclose a list of the useful plants cultivated in the royal gardens at the Isle of France in 1790, and at that time ready for distribution among the colonists. The publication of such a document will not only show the attention paid by the French nation, while under their ancient government, to the transportation of useful plants from one part of the globe to another, but set an example to our Royal Gardens at Saint Vincent's, instituted for similar purposes, though possibly not supplied with equal funds,* and will also encourage the West India planters to apply for and receive such plants, of which there are many, as are now there ready for delivery.

I have, &c.

Earl of Liverpool. (Signed) Joseph Banks.

Mr. Thomas Rutton to Mr. William Fawkener.

Sir, Charing Cross, 14th November 1796.

I take the liberty of requesting you to represent to the Right Honourable the Lords of the Committee of Council appointed for the Consideration of all Matters relating to Trade and Foreign Plantations—

That I have individually consulted with several *grocers* on the subject of the cloves [from Dominica], who, upon examining the samples produced by the Lords to Messrs. Bourdillon, Arnaud, Nanson, and Ruttou, have uniformly given it as their opinion that they will answer every culinary purpose as well as those of the Spice Islands in the East Indies; and that if the price of cloves could be materially reduced, the consumption might be considerably increased. The samples were not sufficient for the *chymist* or *distiller* to make any experiment.

I am, &c.

Wm. Fawkener, Esq. (Signed) Thomas Rutton.

In addition to the clove tree, M. Buée was instrumental in introducing to Dominica "the bread fruit, the cinnamon, the black pepper, and "many sorts of fruit trees from different parts of the world, for several "of which," he says, "I am indebted to Mr. Anderson, of His Majesty's "Botanic Garden at St. Vincent." Of the cinnamon tree he writes in the last paragraph of his report as follows: "Having succeeded in propagating the cinnamon tree from slips, and from them having now a "great many trees in my possession, this will be the subject of my "future remarks. I will only observe at present that hedges might be "made of that tree to shelter other productions, and by that means "prove a double advantage."

The subsequent history of M. Buée's enterprises at Dominica appears not to have been so satisfactory as they deserved. In Dr. Nicholls's

* An account of the old Botanic Garden at St. Vincent was given by the Rev. Lansdown Guilding, B.A., F.R.A.S. Glasgow: Richard Griffin & Co., 1825. *See* also *Kew Bulletin*, 1892, pp. 92–104.

Text-Book of Agriculture, lately published in this country, p. 184, the following account is given :—

"The clove, like the nutmeg tree, is a native of the Moluccas, or Spice Islands. . . . . The French succeeded in carrying living plants to Cayenne, and from thence it was brought in the year 1789 to Dominica by a M. Buée, who successfully cultivated the clove and other spices only to be ruined in the end by the operation of the duties imposed on West Indian spices in England, through the jealousy of influential persons who were interested in the trade of the East. Although 100 years have elapsed since the unfortunate M. Buée introduced the spices into Dominica, one of the clove trees planted by him is still alive and flourishing, and the cinnamon bushes have become almost wild, as the seeds are disseminated by birds."

At the present time the clove tree is found in nearly every one of the West Indian Islands, and especially at Jamaica, Trinidad, Grenada, St. Vincent, and Dominica. It is nowhere yet established in regular plantations, and the export of West Indian cloves is comparatively trifling. The largest number of trees is probably found in Grenada, and in that "Spice Island," nutmegs, mace and cloves are exported to the value of about 10,000*l.* to 12,000*l.* Very shortly this value will be considerably increased, as there is extensive planting of spice trees going on, and one proprietor alone has planted about 250 to 300 acres with nutmeg trees, all of which are in excellent condition, and promising heavy crops (*Kew Bulletin*, 1891, p. 147). In Jamaica clove trees would probably flourish on the rich clay lands of the Red Hills, in the parish of St. Andrew, and recently, we notice, the Director of the Botanical Department in that island has issued hints on the treatment of plants which were offered in quantities at the local Botanical Gardens.

CCCII.—CHINESE WHITE WAX.

Chemically this is Cetyl Cerotate. It is defined in Watts's *Dictionary of Chemistry* as "a peculiar waxy substance obtained from "China, where it is produced on certain trees by the puncture of a "species of *Coccus*." Dr. Bretschneider in "Notes on some botanical "questions connected with the Export Trade of China," (1880), remarks, "whilst the insect which produces this wax (*Coccus Pela*) "and its habits have been well studied, the trees on which it is fed are "still imperfectly known."

In 1883 Mr. Field delivered a course of lectures on "Illuminating agents." He stated then that the consumption of insect wax by the Chinese is very large. Little of it apparently finds its way into British trade, "its chief use being to break the grain of spermaceti, the two "crystallisations neutralising each other." A subsequent correspondence with Mr. Field revealed the paucity and uncertainty of our knowledge of the product. Kew accordingly suggested to the Foreign Office that it might be made the subject of inquiry by Her Majesty's Consuls in China.

The five very able reports which are now printed were the result. Their contents have reached the public eye in various forms. If they have not appeared earlier in the pages of the *Bulletin*, it is owing to the

extreme pressure on its space. They are now published, if somewhat tardily, in recognition of the pains bestowed upon them by the able officials who prepared them, and also because in this form they will reach the eye of many persons who perhaps would not obtain otherwise the information they contain.

The reports taken together supplement one another, and, as a whole, give an exhaustive account of one of the most curious industries in the world. The tree on which the insect deposits its eggs is undoubtedly *Ligustrum lucidum*, Ait., of this the specimens collected by Scott and Hosie leave no doubt. According to Dr. Henry, in the Province of Hupeh, at Ichang, Nanto, and the mountains to the northward, it is the commonest evergreen tree, from 20 to 30 feet high. According to Hance (Journ. Linn. Soc., xiii., p. 82) *Ligustrum japonicum*, Thunb., Dr. Bretschneider states, "on native authority, is used for rearing the wax insect on." This is an eastern species; if used at all it is probably only a casual circumstance.

The tree on which the wax is produced is an Ash which has usually been referred to *Fraxinus chinensis*, Roxb. To this Mr. Hemsley, in the *Index Floræ Sinensis*, refers the specimens collected by Cooper, Hosie, and Scott. Roxburgh's species is not, however, wholly free from ambiguity, and M. Franchet, who was consulted on the subject, preferred to refer Hosie's specimens to *Fraxinus rhyncophylla*, Hance. He remarks, however, that the Chinese embrace under one name, Pe-la-shu, all the species of *Fraxinus* capable of supporting the wax insect. Mr. Hemsley finds that the limitation of the Asiatic species of Ash is difficult and uncertain, and he reduces Hance's species to a variety of *F. chinensis*.

The most extraordinary feature in the industry is the process, so graphically described in the reports of transporting the eggs of the *Coccus* from the district where they are produced to that in which the wax is obtained. The *rationale* of this still seems obscure. Mr. Baber states:—"No reproduction of the insect occurs in the Chia-ting plain, "because the twigs of the trees are lopped off and boiled." But it is not obvious why *all* should be boiled, and why nurseries should not be maintained. A statement of Mr. Cooper's may perhaps supply the clue to the explanation:—"The insects owing to their loss of fecundity, have "to be renewed [in Chekiang] every third year, the egg pouches being "imported from the neighbouring province of Fuh Kien."

The industry seems to be a decaying one, and perhaps in a few years will be scarcely remembered, except for the accounts which have been preserved of it. In a Foreign Office Report [1892, No. 1,097] it is stated:—"The export of white wax has shown great decline in recent "years. In 1888 the figures were 15,410 piculs; in 1891, 5,724 "piculs. Its use for giving a hard coating to the soft native tallow "candles seems to be decreasing in the seaports; foreign candles and "mineral oil having no doubt supplanted to some extent these native "lights. The crop was reported fair, but the price of 35 taels per picul "is very much less than that which it formerly commanded. It was "some years ago priced at 200 taels. Under the circumstances the "bulk of the crop is retained for local use."

A similar industry seems to exist in Japan, though nothing is known as to the details. In the Kew Museums are specimens of Ibota wax obtained from *Ligustrum Ibota*, Sieb., which also occurs in China. This is no doubt an insect wax, the produce of a *Coccus* living on the plant.

(No. 10.) Her Majesty's Consulate, Ningpo,
My Lord, June 20th, 1884.

On receipt of Mr. Currie's despatch, dated Foreign Office, February 1st, I at once applied myself towards ascertaining what information regarding the wax insect had been already acquired and recorded by Europeans. I enclose a list of authorities, noting those to which I have obtained access. Having studied these, I paid a visit to the Fathers Rathouis and Hende, of the Jesuit Mission of Siccawei, near Shanghai, and subsequently instituted inquiries as to the localities in this consular district that produced the wax, and under what conditions. Unable, however, to obtain any positive information from the natives whose services I had engaged, I requested and obtained the permission of Her Majesty's Minister to explore the country myself, and more particularly those parts in which I knew that native wax was offered for sale. I have now the honour to report to your Lordship the result of my expedition.

In the Fêng-hua district, whose town is 40 miles from this, I first noticed the ash tree (*Fraxinus chinensis*) growing on the banks of canals at the places where water was being raised for irrigating the paddy fields. The tree is a handsome one, with a straight stem, a shapely head, and abundant foliage. It is planted as a shade for the labourers and cattle. Its height of trunk hinders its coming into general use for this purpose. In the neighbourhood of Ningpo, the Persian lilac, camphor, and tallow trees are preferred. This ash does not thrive on sodden ground. Regarding this ash, the intendant of this circuit, a Yün-nan man, informed me in the course of conversation that in western China the shoots of the ash attain a height of eight feet in a year, and it is from them that abundant wax is formed. It is easily propagated by means of cuttings. I have now in the garden of this consulate shoots of near three feet long from slips given me by Father Rathouis.

I failed, however, to discover during my tour of some 400 miles anything tending to show that the practice exists of placing the pouches of the insect on this tree. On the contrary the nests would appear to be affixed to the large-leaved privet (*Ligustrum lucidum*) only. Of this latter tree (for it is more than a shrub) I noticed on the hill sides two or three groves or plantations.

On my journey, despite the constant inquiries I made, I was unable to find anyone who knew anything of the culture of the wax insect till my arrival at the temple near the summit of the F'ien-t'ai mountain, the head-quarters of Buddhism in the province. There the steward of the monastery told me that the priests yearly gathered the wild wax from the privets that grew in the woods about the hills, but he was not aware that they transferred the insects from one tree to another. It is difficult, he said, to find the insect before the wax be forthcoming. This I can confirm, for on the following day I, with a priest, searched in vain.

On reaching the city of Kiu-hua, near the centre of the province, I inquired at the candle shops—as, indeed, I had done at each town I had previously passed—for this native wax, and at what seemed to me of the largest, found a store of several hundredweight, in the form of broken up cakes. It was, I observed, not so purely white as that imported from Hankow, but I was assured it was unadulterated, and that the dinginess of the colour was due to an admixture of wild wax. The price of this substance is variable. At Kui-hau the average may be

taken as 60 dollars for 100 catties, say, some 9*l.* per cwt. The custom at Kiu-hua is to allow 18 taels, instead of the usual 16, to the catty when dealing in it. I purchased a small quantity, $5\frac{1}{2}$ oz., and for this was charged 190 cash, or about, $7\frac{3}{4}d.$

The wax is brought to Kiu-hua from the three districts of Yung-kang, Tung-yang, and Wu-i. It is the product of insects kept on the large-leaved privet. The tree is grown from cuttings, and the plantations are carefully kept clear of undergrowth of any kind in order to prevent the insects straying. The slopes and infertile ground at the foot of hills are preferred for this purpose.

The insects, owing to their loss of fecundity, have to be renewed every third year, the egg pouches being imported from the neighbouring province of Fuh-kien. I could obtain no clue to the cause of their infallibly dying out. These pouches will only bear carriage during the fifteen days of incubation, which appears to be also the only time in which the insects are capable of being transferred.

Insects that escape and are found wild take not only to the holly but two or three other shrubs, as the *Gardenia florida* and *Ligustrum glabrum*. The wax produced on these is not nearly as abundant as that afforded by the insects reared on the large-leaved privet.

The wax producers are preyed upon by a ladybird or beetle resembling that insect and by a hairy caterpillar.

The season for gathering the wax is the middle of the eighth month, which would correspond with the end of September or beginning of October. The deposit is scraped off, the smaller twigs being, however, cut. The twigs so cut and the wax are steamed together, and the resultant strained to clear it from impurities.

The large-leaved privet, which I assume to be the *kan-lah-shu* (dry wax tree) of Mr. A. Wylie, is not known by that name. The *shui-lah-shu* (water wax tree), to which the same gentleman makes reference and which I imagine is the ash, was, I heard, the habitat of an insect that produced yellow wax, but no one knows of its growing in the prefecture. I cannot consider this information to be depended on.

The seeds of the large-leaved privet are used as a tonic in Chinese medicine under the name of *nü-chên-tsz*—nü-chên being the classical (? scientific) name of the plant.

The average supply of late years brought to Kiu-hua for sale approaches 6,000 piculs, or about 360 tons. The value for years has not been apparently effected, except by the variations consequent on the ordinary laws of supply and demand, the latter being more steady than the former.

Before the rebellion the supply was at least threefold. The present facility of transport from Hankow has prevented the industry resuming its former proportions.

The above information was collected from the candlemaker and from an educated man who had resided in Yung-kang. The latter has an orchard in Kiu-hua city, and had introduced the insects into it a few years since. They disappeared, however, in the course of two or three years. The distance of the city from any port, and the necessity of expediting my return, prevented my remaining in the Kiu-hua country with the intent of visiting the sources of production.

The demand for insect wax is principally for the exterior coating of the candles in common use. Though beeswax is abundant and cheap at Kiu-hua, insect wax is found to be more economical for this purpose. The introduction of kerosene, while it has reduced the consumption of rapeseed oil in these parts, has not effected the sale of candles, these being employed for celebrations, such as feasts, religious observances, and the like, and for lanterns, which are carried by every one out after dark.

Another very general purpose for which it is employed is in sizing certain kinds of paper in common use for notes and visiting cards, with the object of giving them a lustrous appearance.

At T'ai-chou-fu an industry is carried on for the manufacture of light articles of Chinese furniture. These are made from the wood of the weeping cypress (*Cupressus Fortunei*). After being smoothed with the dry sheath of a certain rush they are polished with insect wax.

At Amoy years ago many of the inner surfaces of the walls of European houses were coated with shell lime, to which a very smooth surface was given. This was then stained by being washed with some colour, not distemper, and when dry rubbed with insect wax. The walls thus treated stood the climate well, and were found preferable to those lime-washed or oil-painted, as having a brighter appearance, while at the same time they were more cleanly.

Women employ the wax as a fixatrice for their hair, chemists as a component of plaisters and a coating for pills, though for these purposes bleached beeswax is frequently used. I cannot find that here it is applied to wove materials of any kind,

I have preferred retailing the results of my own observation and inquiry, to furnishing the elaborate report that appears called for in Mr. Currie's despatch, as I have not access to much that has been written on the subject, nor have I the leisure or means for spending so much time away from my consular duties in the insect wax country as to fit me to write an exhaustive monograph.

Apart from this, in treating such a subject I need the science of a trained observer to make it worth my own or another's while for me to devote so much time and work as such a task would require; neither can I look to the natives for assistance, as their knowledge of natural history is as limited as their credulity and appetite for the marvellous are unbounded. I trust, however, that the practical information now supplied by me may be found of some value.

I append a list of prices ruling at this port during the last six years, whereby were compiled the quarterly returns of the maritime customs. The tables from which this list is extracted are drawn up with great care by experienced men.

The specimens asked for I am sending direct to Kew Gardens, such of them, that is, as I have been able to collect as yet. I hope in the autumn to obtain twigs coated with the wax and seeds to complete the collection.

I have, &c.
(Signed) Wm. M. Cooper.

Her Majesty's Principal Secretary of State,
for Foreign Affairs.

Prices of the Imported Insect Wax at Ningpo during the Years 1878 to 1884.

These prices were obtained by the Foreign Customs for the purpose of estimating the values in their returns. They are given in Hai-kwan Taels per Treaty Picul of 133⅓ lbs.

		Taels.
1878	1st quarter, March 31st	49
	2nd „ June 30th	45
	3rd „ September 30th	48
	4th „ December 31st	44
1879	1st quarter	50
	2nd „	44
	3rd „	44
	4th „	50
1880	1st „	50
	2nd „	52
	3rd „	49·20
	4th „	75
1881	1st „	68
	2nd „	70
	3rd „	56
	4th „	56
1882	1st „	50
	2nd „	60
	3rd „	56
	4th „	54
1883	1st „	50
	2nd „	48
	3rd „	54
	4th „	54
1884	1st „	60
	Average price	Taels 53·45

N.B.—At present, 1 Hai-kuan Tael = 5/9 sterling.

List of Authorities on the White Insect Wax of China.

1. Martini's Atlas Sinensis, 1655.
2. Père Gaspar Chauseaune: Memoir published in Panth. lib. III. 830, 1750.
3. *Id.:* Memoir in Lettres Edifiantes, &c., vol. XXIII., pp. 146 seqq. (Paris 1781.)
4. L'Abbé Grosier.
5. Sir George Staunton.
6. Comptes Rendus for 1844. Tome X., page 618.
7. Stanislaus Julien: Industries de l'Empire Chinois, p. 109. Translated from the "Nung Chêng Ch' üan Shu."
8. Dr. Macgowan's paper in the Journal of the Agricultural and Horticultural Society of India, vol. VII., 1850.
9. Pharmaceutical Journal, Feb. 1862.
10. Hanbury: Notes on Chinese Materia Medica, p. 46, 1862.
11. *Id.:* Science Papers, page 60.
12. Roxburgh: Flora Indica, vol. I., p. 148.
13. Wylie: Memoir in Transactions of the North China Branch of the Royal Asiatic Society for 1868.
14. Mesny: Monograph in "N. China Daily News."
15. Richthofen: Letters to the Shanghai Chamber of Commerce, No. VII., of May 1872, page 52.

16. Etude sur le Coccus pé la ; by Père Rathouis, 1880.
17. Hosie : Blue Book, China, No. 2, of 1884.

Of the above, Nos. 1, 2, 3, 7, 8, 9, 10, 12, 13, 15, 16, and 17 have been consulted by me.

Report on the Production of White Wax in Ssŭ-ch'uan.

A rush wick in a saucer of oil furnishes the common artificial light of the Chinese ; but in all cases where a lantern has to be illuminated, or a light transported, or a votive offering made to a shrine, a candle becomes desirable. Animal tallow is very little used in Ssŭ-ch'uan, but an excellent substitute is obtained from the seeds of the *Chuan-tzŭ shu* and the *Ch'i shu*, two indigenous trees. The former is the well known tallow tree (*Stillingia sebifera*), the seeds of which are boiled, and the tallow, floating on the surface, is skimmed off. The seeds of the *Ch'i shu*, or Lacquer tree, yield a substance which resembles beeswax in appearance, and is freely used to adulterate that product.

The defect of these vegetable tallows is that they melt at too low a temperature. *Stillingia* tallow begins to run at about 95° Fahrenheit, and Lacquer wax* at some nine or ten degrees higher, and it becomes requisite to procure a harder wax with which to coat candles made from them. For this purpose the famous insect-wax, or white wax, of *Ssŭ-ch'uan*, which melts at about 160° is employed ; an article which has hitherto been the chief source of wealth to the population of the *Chia-ting* plain and the remote valley of *Chien-ch'ang*.

An unlucky accident prevented Baron Ferdinand von Richthofen from reaching *Chien-ch'ang*, but he succeeded in gathering from native informants an account of the wax productions, which, except for one or two unavoidable errors, is accurate enough. To save the trouble of reference and at the same time to explain my text, I quote his remarks :—

"White wax (*Pê-la*). This is a very valuable and very interesting product of *Ssŭ-ch'uan*. It is largely consumed in the country, and much of it is exported to other provinces. The white wax of commerce is made exclusively in the Department of *Chia-ting Fu*, near the western border of the 'Red Basin.' *Ssŭ-ch'uan* people know that it is also made in *Shantung*, *Chêkiang*, and *Fuh-kien*, but speak with contempt of the wax of those provinces. According to my information none is made in *Kwei-chow* and *Yünnan*, or in any of the northern provinces. The department of *Chia-ting Fu* is a region where much level ground spreads between gentle hills, and bears, therefore, an exceptional character in a country so uniformly hilly as *Ssŭ-ch'uan*. Its climate is warmer than that of the plain of *Ch'êng-tu Fu* but not so warm† as that of the valley of *Ning-yuan Fu*, which is better known as the region of *Chien-ch'ang* and highly reputed for the beauty of its scenery. With admirable sagacity the Chinese have found that the breeding of this wax insect, and the production of the wax through it, are two distinct processes which cannot be combined profitably in one and the same locality, but if judiciously separated may lead to unexpected perfection.

* The Lacquer wax is, of course, entirely distinct from the lacquer or varnish obtained from the same tree by incision of its trunk.

† The Baron is not, of course responsible for the opinion that *Chien-ch'ang* is warmer than the *Chia-ting* plain. In my experience it is 12 or 15 Fahrenheit degrees colder ; being some 3,000 feet higher in level.

"The regions of *Chien-ch'ang* and of *Chia-ting Fu* divide the labours and the profits. In *Chien-ch'ang*, near the cities of *Ning-yuan Fu* and *Hui-li Chow*, the insect tree is planted, an evergreen tree with large and pointed ovate leaves. It is so valuable that it constitutes a separate article of property, distinct from the soil on which it grows. On this tree the wax insect lives and breeds, but secretes little wax. It is evidently under conditions best fitted for its healthy development. The wax which is made in *Chien-ch'ang* is just sufficient for the small local consumption and the supply of *Yünnan*. At the end of April the *Chien-ch'ang* people leave their country in great numbers, each with a load of the precious eggs on his back, and travel on a very mountainous road to *Chia-ting Fu*, which they reach after a fortnight's arduous walking. The road is said to present then a very lively aspect, chiefly at night time, when they go with lanterns. The heat of the day must be avoided, because the sun would quickly hatch the eggs. These are described as a substance resembling flour, and contained in a bag of the size and shape of a pea. Three hundred of the little bags weigh one *Tael*. They are eagerly bought up in *Chia-ting Fu*, and immediately put upon the wax-tree. This tree is said to produce no seeds in *Chia-ting Fu*, and to be easily multiplied by cuttings. It is not allowed to grow freely, but is kept short as a stump six or seven feet high. The shoots grow very rapidly. In the following year they serve for harbouring the insect, and, as they must then be cut off, other twigs are allowed to grow in the third year. In the fourth wax is again made, and so on alternately from year to year. When the egg-balls are procured they are folded up six or seven together in a bag of palm-leaf. These bags are suspended on the twigs of the trees. This is all the human labour required. After a few days the insects commence coming out. They spread as a brownish film over the twigs, but do not touch the leaves. The Chinese describe them as having neither shape, nor head, nor eyes, nor feet. It is known that the insect is a species of *Coccus*. Gradually, while the insect is growing, the surface of the twigs becomes encrusted with a white substance; this is the wax. No care whatever is required. The insect has no enemy, and is not even touched by ants. In the latter half of August the twigs are cut off and boiled in water, when the wax rises to the surface. It is then melted and poured into deep pans. It cools down to a translucent and highly crystalline substance. Ten *Taels*' weight of eggs produces from two to three catties of wax."

"The insect produces no eggs in *Chia-ting Fu*. The natives believe that the climate is not warm enough. It appears, however, that the plentiful secretion of wax indicates a sort of diseased state, owing, perhaps, to a too luxurious food. Where the insect breeds, the secretion is much less, and the wax is of an inferior description. The wax trees are planted in fields, either on level ground or on the lowest portions of the slopes of hills. They are very plentiful in the districts of *Omi*, *Chia-chiang*, *Hung-ya*, and *Lo-shan*, all of *Chia-ting Fu*. Every attempt to produce good wax in other regions has failed."

Such is the Baron's account. Since his report was published in the well known "Letters to the Shanghai Chamber of Commerce," I have visited all the places mentioned above, and in the summer of 1887 I traversed the whole length of *Chien-ch'ang*. Its northern boundary is the Fung, or *Ta-tu*, River in *lat.* 29° 20′, and it extends southwards to *Chin-ch'üan* Bridge in *lat.* 27° 11′. It is not until the town of *Lu-ku*, in *lat.* 28° 13′, is reached, that the valley becomes level and populous; north of that point a maze of passes and deep ravines seriously obstructs both cultivation and traffic, and affords every convenience to

the border tribes for attacking convoys and caravans. The comparatively level part of *Chien-ch'ang*, through which the *Ju-ning* river runs, is the centre of the egg culture, but there are besides many outlying spots in which it is successfully conducted.

The general opinion of the Chinese that wax cannot be produced in the districts where the insect is propagated, and conversely that reproduction does not take place in regions which are favourable to the deposit of wax, has led Europeans to suppose that the plentiful excretion results from a diseased state of the insect, brought about by its transportation to an uncongenial climate. But I soon found that the alleged incompatibility of wax-making with breeding is accounted for in a much simpler way. No large deposit of wax takes place in *Chien-ch'ang*, because the eggs are carried away to other districts. No reproduction of the insect occurs in the *Chia-ting* plain, because the twigs of the trees are lopped off and boiled. It is clear that you cannot have wax if you exile the insects, and that you cannot have insects if you boil them down. But in *Chien-wei-Hsien*, on the *Min* river, where the conditions of climate, soil, and situation resemble those of the neighbouring wax-district of *Chia-ting*, both insects and wax are produced, separately, with perfect success; as is also the case in the *Fu-lin* valley, immediately south of *Ch'ing-ch'i Hsien*, where the conditions are much the same as in the egg district of *Chien-ch'ang*.

I have twice visited the *Fu-lin* valley, into which the wax production has only lately been introduced (in 1874 or 1875), and as the natives are very willing to give information about their new industry, I easily acquired a plentiful stock of fact and fiction. My second visit was in May 1878, when the eggs had just been placed on the trees. The eggs are contained in a spherical gall of a dark brown colour, a quarter of an inch to three-eighths in diameter, which is thin, hard, and brittle in substance, but becomes softer and slightly flexible when wet. There is a more or less circular opening or breach at the point where the gall* was detached from the tree on which it was originally formed. Of such galls I opened 40 or more, and found the less mature full of a white powder resembling wheat-flour, but coarser, which acquires a yellow tinge as the time approaches for the birth of the insects. Each grain of this is an egg. In most of the galls which I examined the eggs were nearly all hatched, and the brood was actively crawling out through the circular breach. Every gall must certainly yield, on a moderate estimate, more than a thousand insects, for when these first march out into the world they are so exceedingly small that the unassisted eye can hardly detect individuals except under favourable conditions of light and colour. Close and sustained scrutiny with a strong magnifying glass shows that they have six legs and a pair of antennæ, and that they are of two kinds, white and red, which it may be assumed are the two sexes. The white are reported to grow larger than the red, ultimately reaching the size of a Sesamum grain. I suppose the red kind to be the female. What appears to be her alimentary canal is perceptible through her back, but the male is more opaque.

The natives affirm that one reason why the egg-galls must be carried with all speed to the wax country is to forestall the ravages of the "*wax-dog*," a parasite which, in their opinion, is formed in the gall along with the nascent insects, and soon devours them unless they are forthwith put to the trees. I was very eager to discover this insect cuckoo, but I found a specimen without any search in the first gall I

* "Gall" is an inaccurate term in this application, but it serves the purpose of description.

examined—a white, oval, phlegmatic, obese, waxy, legless grub, about a hundred times as big as its victims, a terrible parasite indeed. It is called the *wax-dog* on account of its supposed voracity, and sometimes the "*wax buffalo*" from its comparatively gigantic size. It lies in a bed of greasy fluff, encompassed by its prey. The second gall I opened also contained a buffalo; and so did the third, and so did the fourth, and so did every one I examined which contained anything at all. I had counted somewhere into the twenties, when in a gall of not more than average size came suddenly upon no less than six of these greasy monsters all ensconced together.

Insect life under such conditions seems scarcely worth having, if, that is to say, one's sympathies are on the side of the devoured. But by this time I had collected a whole herd of buffaloes, and, on comparing them, the backs of some seemed to be breaking out into ridges and plates, as if under a phase of transformation. It should be remembered that the galls which I was examining were in different stages of maturity, some being perhaps five or six days more advanced than others; the contents of some were barely hatched, while a few were mere empty withered husks; and in one of the latter I found to my exceeding surprise and excitement, a jet black muscular beetle, which sprang actively from the husk, lifted its elytra, unpacked its wings, and flew solemnly down the breeze before I could secure it.

Very possibly, therefore, the natives are right in supposing the buffalo to be an interloper; and yet I was for a long time persuaded that this waxy grub is the mother of the brood, and even now I am reluctant to abandon the belief. But according to all analogy the Coccus-mother ought to die some time before the young are hatched, and dry up into a mummy attached to the inside of the gall, which is a kind of carapace. Moreover, how is it possible to account for six mothers under the same roof? In any case it seems difficult to explain the presence of the beetle. He was much too large to have crept in through the breach, and apparently much too mature to have been developed inside in so short a time.

Such speculations and inquiries must be left to the professional entomologist. It is time to return to our red and white insects. The mother-gall being placed upon a suitable tree, the young brood march out at a good round pace and ascend the branches, the red females leading the way; after a period of desultory wandering they reach the leaves, on which they seem to feed, but the quantity they consume is imperceptible, and the leaves remain to all appearance uninjured. In about ten days they return to the thin upper twigs, where, according to the natives, the males begin to excrete wax, and the females to form the galls either amid the wax or apart from it. The deposit of wax gradually increases until a hundred days from the date when the galls were attached to the tree, and the twigs are then almost entirely coated with a layer one-third of an inch or less in thickness. The whole process extends from the middle of May to the end of August. While still on the tree, the deposit is a kind of dense greasy fluff, and looks very much like sulphate of quinine. The twigs, with their coating, are cut into convenient lengths and put into a pot with a little water. After boiling point has been reached the fire is removed, and when ebullition ceases the poorer quality of wax, with the hard parts of the insects and other impurities, sinks to the bottom. The clear wax is skimmed from the surface and poured into a mould, where it solidifies into the wax-cakes of commerce; the residue is turned into a bag through which it is squeezed, and yields an inferior quality.

The wax must be gathered in due season, for in the natural order of things the male ultimately extricates himself from the deposit and makes off. If they are allowed to escape, seven-eighths of the wax, I was told, would be lost.

The gall first appears as a small wart or barnacle on the bark, and gradually swells until February, when it has become a globe adhering to the bark by the lip of a circular orifice. The smaller the orifice the more productive, it is said, the eggs are likely to prove. At this stage the galls contain only a milky liquid; the floury eggs begin to form in March, and the so-called buffalo appears contemporaneously. In the *Fu-lin* valley, where, as I have said, most of these facts and opinions were gathered, the galls are broken from the tree during the floury stage, and being folded up a dozen or so together in a broad leaf, usually that of the *Fung-tzu* (*Elæocarpus*), are tied to a branch of a neighbouring tree. But nearly all the galls grown in *Chien-ch'ang* are conveyed to *Chia-ting* plain, a few only being retained for purposes of reproduction. It is of course impossible to carry them while the contents are liquid; the milk would run out at the hole. Unluckily for carriers the interval between the milky and the hatching stage is short, and the young insects are just as prone to run out as the milk. Hence the journey has to be made with all possible despatch; the carriers cannot march while the sun is high, for the heat would hatch the eggs. The stages must therefore be made by night, and everyone must carry a lantern. It is also apparent that the whole body must set out within the same day or two, and since their average number is about fifteen thousand, all hastening by the light of their lanterns over some of the wildest passes and plateaux in the world, each eager to outstrip his fellow and get first to ferry or hostel, it will be easily imagined that their march is like the headlong flight of an army. The *Fung* river is more generally known in western *Ssŭ-ch'uan* as the *Ta-tu*, or "Great Ferry," river, from its crossing by the egg-carriers near *Tu-lin*. The spectacle of its passage during the egg season, as the ferrymen told us, "is more exciting than the slaughter of the rebels," alluding to the extirpation of *Taiping* hordes under the famous *Shih-ta-k'ai*, which was consummated exactly at this very spot in 1863.

Most of the carriers are natives of the *Chia-ting* district. The chief market to which they repair for the purchase of eggs is the large village of *Tê-ch'ang*, on the right bank of the *An-ning* river, in *lat.* 27° 24′. Those who are unable to procure eggs, the supply of which is variable and not seldom insufficient, travel to *Hui-li-chou* and return with a burden of Yünnan opium. The egg-carriers mostly take the route by *Fu-lin* and the *So-i-ling* pass to *O-mi-hsien*, which is the shortest; others prefer to go by *Fu-lin*, the *Fa-hsaing-ling* pass, and *Ya-chou*; a certain number go round by *Tung-ch'uan Fu*; a few choose a circuitous way by *Fa-chien-lu*, which affords the advantage of coolness. On reaching the *Chia-ting* plain the galls are attached to the trees with as little delay as possible.

Such is the history, so far as I could ascertain it, of the life and adventures of the wax insect. I cannot at any rate be in error as regards its shape and appearance. But on comparing the testimony of Mr. T. T. Cooper, the only other traveller who reports that he has seen the creature, a downright contradiction appears. He writes that near *Wei-see*, on the Tibeto-Yünnan frontier, he noticed for the first time the "white wax insect, which produces the famous so-called vegetable wax "of *Ssŭ-ch'uan*. The branches of the smaller trees and shrubs along "the road for a great distance appeared to be covered with snow from

" the quantities of these insects, resembling small moths of a very " delicate white colour with a fluffy tail curling over the back."* So precise a statement cannot be questioned, and the account of the *fluffy tail curling over the back* is supported by what Dr. Wells Williams records of a similar insect. "The *Peh-la-shu*, or white wax tree, " affords nourishment to an insect called *Cicada cimbata*. It is the " larva which furnishes the wax. The fly was first discovered by " Staunton on the coast of Cochin China ; it has curious pectinated " appendages on the back, and the whole insect is covered with a white " powder, which is imparted to the stems of the plants it inhabits, and " from whose bark it is collected by the natives."†

These descriptions differ so widely from what I saw of the *Chien-ch'ang Coccus*, that there is no way of explaining the discrepancy unless on the supposition that Mr. Cooper's insect belongs to a totally different species. I am all the more disposed to accept this solution, since I observed in the groves round Chungking certain kinds of bamboo in the autumn apparently splashed with whitewash, and found on close inspection that the phenomenon was caused by a kind of wax in course of secretion by a small insect provided with two plumes which spring from its hindquarters and wave continually over its back. But this wax is much too sparse and foul to be utilised commercially.

The production of insect-wax, however, is by no means confined to *Ssŭ-ch'uan*. A wide field of inquiry awaits the explorer of this and many similar subjects. Baron V. Richthofen, as above quoted, cites Shantung, Chêkiang, and Fuh-kien as provinces which furnish the product. The late Mr. Consul Markham found it in the Ningpo hills, and from other sources I gather that it is grown in the province of Honan, in the island of Hainan, and in Japan. What may be the nature of the insects which furnish the various kinds can only be discovered by travel and leisurely observation, and it should not be prematurely assumed that they are identical with the *Coccus* of *Chien-ch'ang*. Even in Ssŭ-ch'uan there is a distinct variety, of which all I can learn is that the eggs are attached to trees, as in the culture of white wax, and that oak trees only are suitable, for which reason the product is called *Ch'ing-kang La*, or oak-wax. It is used for the same purpose as ordinary white wax, and is almost as hard, but acquires a brown colour from the oak bark.

The tree on which the insects are bred in *Chien-ch'ang* is called the " *Chung-shu*," or insect tree, and that on to which they are transplanted in *Chia-ting* is known as the " *La-shu*," or wax tree ; but either tree may be used for either purpose, and practically the two names are applied indiscriminately, except where precision of expression is attempted by natives of uncommon intelligence and experience. The insect tree is very common throughout *Ssŭ-ch'uan*, where it is also called " *Pao-kê-tsao*," a singular term which means " *crackling flea*," and is said to be derived from a peculiarity of the wood, which, when burned, jumps and sputters in the fire. It is a handsome umbrageous evergreen, twelve or fifteen feet high, having glossy pointed leaves about three inches long, much resembling orange leaves, but thicker,

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* " Travels *of a Pioneer of Commerce*," pp. 323 and 429. On his return journey Mr. Cooper traversed the *Chia-ting* district, and he describes the method of wax culture. But as he passed through in October, two months after the wax had been gathered, his account must have been taken from hearsay only, and he seems too hastily to have assumed that the insect is of the same kind as he saw near *Wei-see*.

† " The Middle Kingdom " : first edition, vol. i., p. 274.

and of a deeper green, with perfectly smooth edges. I have observed it growing among orange trees near *Fu-lin*. The leaf stems spring in pairs, and not alternately, from the central twig. I was too late to see the flowers, but a description of them is supplied by Captain Gill.

"These trees," he writes, "are in appearance like an orange, with a "small leaf. They have a very small white flower, that grows in large "sprays now (20th July), covered with masses of blossom, and a strong "smell, which was not very sweet, filled the air."*

The wax tree of *Chia-ting* is kept polled so as to supply young shoots, and in this state it resembles a pollard willow, being reduced to a very ugly stump some eight or nine feet high. All over the *Chia-ting* plain it is planted on the divisions of the ricefields, in such quantities that at 80 or 100 yards distance from the traveller the trees close in upon one another, as it were, and shut out the view. The wax tree is deciduous. It has pointed ovate leaves of a light green colour, smaller than those of the insect tree, with leaf stems springing alternately from the twigs.

Passages from native works referring to the trees have been extracted and translated by Professor Stanislaus Julien, and are reproduced in the "Univers Pittoresque," in the volumes which treat of China. The Professor sums up his deductions in the statement that "the Chinese "rear wax insects from three kinds (of trees), of which two are well "known in Europe. They are the *Nŭ-chĕn* (*Rhus succedanea*, accord-"ing to Adolphe Brogniart), the *T'ung-ch'ing* (*Ligustrum glabrum*, "according to A. Remusat), and the *Shui-chin* (recognised by A. "Remusat as *Hibiscus syriacus*.)"

These native names are† unknown in Ssŭ-ch'uan, but the description given above may perhaps aid botanists in judging whether they are justified.

The decline of so simple and curious an industry cannot be viewed without a feeling of regret, but the following figures show how the production and trade is failing. The export of eggs from *Chien-ch'ang* was—

In 1876	about	30,000	burdens.
„ 1877	„	12,000	„
„ 1878	„	1,200	„

A burden consists of 64 packets, each packet containing 18 Chinese ounces (or 24 English ounces) of eggs; but the heat of the journey hatching the insects *en route* reduces the weight by about one-third. One packet may be expected to yield nearly four *catties* (say five and a quarter English pounds) of wax. The production of wax has therefore been roughly—

In 1876,	10,000,000	lbs.
„ 1877,	4,000,000	„
„ 1878,	400,000	„

The cost price of the eggs in *Chien-ch'ang* ranges from 6*l*. to 12*l*. per burden, and about 26*s*. per burden must be paid at various points for duty and excise. For sale on arrival the price varies between 10*l*. and 30*l*.

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* "*The River of Golden Sand*," vol. ii., pp. 62, 63.

† From inquiries in drug-shops, however, I found that the berries of the *Pao-kê-tsao* are known as "*false Nŭ-chĕn*," and that "*true Nŭ-chĕn berries*," used in native medicine, are yielded by a tree named *T'ung-ching*. But the identification of the Chinese book-names of plants with local names is hopelessly involved and obscure, and little can be gained by the most wearisome research.

The market price of the wax in *Chia-ting* is about 9*l.* per hundredweight, having continuously fallen of late years. It is said that 20 years ago the price was as high as 70*l.* per cwt., but this seems quite incredible. There can be no doubt that the depreciation is consequent upon the enormous import of kerosene oil; but *Chung-king* merchants persuade themselves that it should be attributed to the invention of gas and its introduction into Shanghai.

(Signed) E. Colborne Baber.

Chung-king, 10th June 1879.

Revised and corrected, 30th September 1884.

(Signed) E. C. B.

Note.—The places mentioned above will be found in the map attached to my "Travels and Researches in Western China," published by the Royal Geographical Society. It will be useless to look for them elsewhere.

Insect White Wax.

The subject of Insect white wax may be briefly discussed under the following heads:—

I.—The Insect Tree.
II.—The Insects.
III.—The Wax Tree.
IV.—The Wax.

I.—*The Insect Tree.*

This tree is known to the Chinese in the extreme west of Ssu-ch'uan as the *ch'ung shu* ["Insect Tree"] and the *Tung ch'ing shu* ["Winter Green" or "Evergreen Tree"], while in the east of the province it is generally called the *Pao-ko-tsao* ["Crackling Flea Tree"] owing, as Mr. Baber has explained, to the sputtering of the wood when burned. It is probably the *Ligustrum lucidum* [?] of the botanist; but the specimens I am forwarding to Kew will decide this point. Although it is found scattered about the whole of Ssŭ-ch'uan, its chief habitat is the valley of Ningyuan Fu or Chien-ch'ang in the west of the province. It is an evergreen with leaves which spring in pairs from the branches. They are thick, dark green, glossy, ovate, and pointed. In the end of May or beginning of June the tree bears clusters of small white flowers which give place to small seeds of a dark blue colour.

II.—*The Insects.*

In the month of March 1883 I passed through the Chien-ch'ang valley; but, knowing that Mr. Baber had already reported on the subject of white wax, I confined myself to a mere cursory examination of the insect tree. In this month I found attached to the bark of the boughs and twigs, numerous brown, glazed, pea-shaped excrescences or galls in various stages of development. In the earlier stages they looked like minute univalves clinging to the bark. The larger galls were readily detachable, and when opened, presented either a whitey brown pulpy mass or a crowd of minute animals whose movements were only just perceptible to the naked eye.

During the present year, in the month of May and June respectively, I had the opportunity of examining these galls and their contents with some minuteness in the neighbourhood of Ch'ungk'ing and within the jurisdiction of Chia-ting Fu, the chief wax-producing country in the province.

In the former case I should state that the insects have reached Ch'ungk'ing and its neighbourhood from Chia-ting Fu by short annual stages, being propagated on the insect tree in the country lying between these two cities. Thirty *li* to the east of Ch'ungk'ing I plucked the galls from the trees and on opening them, they are very brittle, I found a swarm of brown creatures, like minute lice, each with six legs and a pair of club *antennæ*, crawling about. The great majority of the galls also contained either a small white bag or cocoon enclosing a chrysalis whose movements again were visible through the thin covering, or a small black beetle. This beetle also has six legs, and is likewise provided with a long proboscis armed with a pair of pincers. It is called by the Chinese in Chia-ting the *Niu-êrh* or "Buffalo," probably from its ungainly appearance. I carried several of the small white bags home with me, and found that within a few days each chrysalis developed into a black beetle or "buffalo." If left undisturbed in the broken gall, the "buffalo" will, heedless of the wax insects which begin to crawl outside and inside the gall, continue to burrow with his proboscis and pincers in the inner lining of the gall, which is apparently his food. The Chinese declare that the beetle eats his minute companions in the gall, or at least hurts them by the pressure of his comparatively heavy body; and it is a fact that the galls from Chien-ch'ang in which the beetles are numerous are sold cheaper than those in which they are absent. A careful examination, however, has forced me to the conclusion that the beetle is there for a far more useful purpose. When a gall is plucked from the insect tree an orifice is disclosed where it was attached to the bark. By this orifice the wax insects escape. If, then, the galls remain attached to the bark, how can the wax insects escape from their imprisonment? I carried back with me a bough with a number of intact galls clinging to it, and watched day by day for signs of life. At last my patience was rewarded by seeing the pincers of the beetle gradually boring a hole through the gall. This hole, when completed, was circular and of sufficient size to allow him to escape from his imprisonment. Although he did not issue when he had broken his prison wall but continued to burrow in the inner lining, the wax insects began to crawl out and in, and I am persuaded that the beetle is a wise provision of nature to afford an outlet for the wax insects. That the beetle devours the insects, may well be doubted, for I endeavoured, but without success, to feed him with the daintiest morsels, he always turned away and recommenced burrowing. When I removed the beetles from the galls some of them made efforts to fly; but at that time their *elytra* were not sufficiently developed, and they had to content themselves with crawling, a movement which, owing to the long proboscis, they performed very clumsily.

There is another insect called the *La kou*, or "Wax Dog," which plays a part in the production of white wax; but, as this creature develops on the wax tree, I will refer to it under the head of *wax*.

At Chia-ting I examined galls that had been brought from the Chien-ch'ang valley. They were suspended on the wax trees and were for the most part empty; but in the very first I opened I found a solitary "buffalo"; the insects had all escaped through the natural orifice.

The Chien-ch'ang valley is the great insect-producing country; but given a number of galls with insects and the insect tree, the insects may be propagated elsewhere, as in Chien-wei Hsien, in the south of Chia-ting Fu, and even in the neighbourhood of Ch'ungk'ing. These latter insects are, however, declared to be inferior and fetch a lower price.

Mr. Baber has graphically described the annual headlong flight of the insect carriers across the mountains from Chien-ch'ang to Chia-ting; but I should mention that their flight is not confined to the night. In 1882 I met insect carriers hurrying in the heat of the day through Kuei-chou to the province of Hunan; but, owing to the greater length of the journey, it is just possible that they were travelling both night and day. The galls I saw in Kuei-chou were packed loose in trays in long bamboo baskets, through which a current of air could freely pass. In Chien-ch'ang, on the other hand, the galls are made up in paper packets, each weighing about 12 Chinese ounces, and a load usually contains 60 odd packets. At their resting places the carriers open up and spread out the packets in cool places in order that the heat may not force the insects to escape from the galls during the journey. As it is, a packet on arrival in Chia-ting is usually an ounce lighter than in Chien-ch'ang. In years of plenty a packet of insects laid down in Chia-ting costs about half a tael; but this year only about a thousand loads are said to have reached Chia-ting from Chien-ch'ang and about thirty loads from Chien-wei. The consequence is that the price has risen to a tael a packet for Chien-ch'ang insects. Chien-wei insects are inferior and cheaper.

In good years a packet of Chien-ch'ang insects will produce three to four catties of wax, the present price of which is about forty taels a picul. In bad years not more than a catty may be expected from a packet, so that altogether the trade has a considerable element of risk in it.

In Chia-ting the insects are divided into two classes called respectively the *La-sha*, or "Wax Sand," and the *Huang sha*, or "Yellow," or "Brown" sand. The former, which are of a reddish white colour, are declared to be the wax producers, while the latter, which are of a brownish colour, are said to produce no wax.

III.—*The Wax Tree.*

This tree, which is known to the Chinese as the *Pai-la-shu*, or "White Wax Tree," is cultivated extensively within the prefecture of Chia-ting, more especially within the O'mei, Lo-shan, and Chien-wei districts. It is, I am told, also grown in the north of the province, but nowhere else have I seen or heard of it. It is usually a stump varying from three or four to a dozen feet, the average height may be taken as six feet, with numerous sprouts or branches rising from its gnarled top. The leaves spring in pairs from the branches; they are light green, ovate, pointed, serrated, and deciduous. The branches are rarely found more than six feet in length, as those on which wax is produced are cut from the stems with the wax. The sprouts of one and two years' growth are too pliant, and it is only in the third year, when they are sufficiently strong to resist the wind, that wax insects are placed on them. In June some of the trees were bearing bunches apparently of seeds in small pods; and the specimens I am forwarding to the Director of Kew Gardens will probably suffice to identify the tree.

IV.—*The Wax.*

The wax insects which reach the wax tree districts from Chien-ch'ang and Chien-wei about the beginning of May, are made up into small packets of twenty or thirty galls, which are inclosed in a leaf of the wood-oil tree, whose edges are fastened together with rice straw. These small packets are then suspended close to the branches under which they hang. A few rough holes are made in the leaf by means of a large needle, so that the insects may find their way through them to the branches.

On emerging from the galls the insects creep rapidly up the branches to the leaves, where they remain for 13 days until their mouths and limbs are strong. During this period they are said to moult, casting off "a hairy garment" which has grown in this short period. They then descend to the tender branches, on the under sides of which they fix themselves to the bark by their mouths. Gradually the upper surfaces of the branches are also dotted with the insects. From the spots where they fix themselves they are said not to move, and I have watched them thickly studded on the bark apparently motionless. The day after removing a branch from a tree, however, I have seen them rushing about wildly, and it may be that they derive their nourishment from the bark; but, unfortunately, I have no microscope sufficiently powerful to discover the nature of their food or the method of excreting the wax. The Chinese idea is that they live on dew, and that the wax perspires from the bodies of the insects. Be this as it may, the specimens of the branches encrusted with the wax show that the insects construct a series of galleries stretching from the bark to the outer surface of the wax.

But I must here introduce the *La kou*, or "Wax Dog," which is developed in the early stage of wax production. I was unable to obtain a specimen of this insect; but it was described to me as a caterpillar in size and appearance like a brown bean. I have a theory, which, however, is unsupported by outside evidence. It may be assumed that there are both sexes of the beetle or "buffalo." On emerging from the gall the beetle is at first unable to fly, or at least unable to fly far, and both sexes doubtless remain for a time among the branches of the wax tree or the insect tree as the case may be. My theory is that the female beetle deposits eggs on the boughs, and that the "wax dog" is the offspring of the "buffalo." I will not go further, but there may be some connexion between this caterpillar and the galls containing the wax insects.

It is said that during the night and early morning the insects relax their hold of the bark, and that during the heat of the day they again take firm hold of it. I saw the owners of the trees moving from tree to tree armed with thick clubs, wherewith they belaboured the stumps in order to shake off the "wax dog," which they assert destroys the wax insects. After the first month or so, however, when the branches are coated with the wax, the "wax dog" is unable to reach the insects, and the trees are no longer belaboured.

Wind and rain are greatly dreaded when the insects are first suspended on the trees, for the tiny creatures are liable to be blown away or drowned.

I have said that white wax is produced in the neighbourhood of Ch'ungk'ing; but, as the wax tree does not grow so far east, the galls containing the insects are taken from one insect tree and placed on other insect trees. This production is inferior in quantity and quality.

When the wax is ready the branches are lopped off, and as much of the wax as possible is removed by hand. This is placed in an iron pot with water, and the wax rising to the surface at melting point is skimmed off and placed in round moulds, whence it emerges as the white wax of commerce. The wax which cannot be removed by hand is placed with the twigs in a pot with water, and the same process is gone through. This wax, as might be expected, is less white, and of an inferior quality. Not satisfied, however, that all the wax has been collected, the operator takes the insects, which have meantime sunk to the bottom of the pot, and placing them in a bag squeezes them until they have given up the last drop of their special product. They are then, an ignominious ending to their short and industrious career, thrown to the pigs.

When I was in Chia-ting in June, the market price of white wax was 40 taels a picul, but, owing to the anticipated decrease in the production of the present year, a rise was soon expected.

White wax is used chiefly in the manufacture of candles. Mr. Baber has pointed out that this wax melts at 160 degrees Fahrenheit, whereas tallow, which forms the general bulk of the candles, melts at 95 degrees. In Ch'ungk'ing an allowance of 3½ mace of white wax is melted up with each catty of tallow to give the latter greater consistency, and the candles of this mixture are dipped in melted white wax, which gives them a harder sheathing and prevents the tallow from running over when they are lighted.

(Signed) Alex. Hosie.

Ch'ungk'ing, July 21, 1884.

Notes on the Production of Insect White Wax in China.

Having read the interesting reports of Mr. Baber and Mr. Hosie on the production of insect wax in the province of Ssŭ-ch'uan, I am induced to offer a few notes on its production in China generally, accompanied by some translations from Chinese authors, which may perhaps throw a little additional light upon the subject.

The earliest mention of this wax in Europe appears to be in Martini's *Novus Atlas Sinensis*, a short geographical description of the provinces of China, published in 1655, after the return of the author after a residence of ten years in the country. It is referred to among the productions of two provinces.

"Urbs Te-gan (prov. Hu-quang).

"Est in hac regione rarum quid, *Alba Cera*, quae a vermiculis elaboratur eo fere artificio quo apes favos suos struunt. Sunt autem hi favi multo minores ac candidissimi, nec vermiculi culti sunt, aut domestici, sed inculti atque agrestes. Ex collectis favis candelas ut ex communi nostrate cera conficiunt, at longe magis alba sunt, a magnatibus, quod majori constent pretio, fere tantum adhiberi solent; nam praeter candorem odorem etiam suavem emittunt cum comburuntur, nihilque sordibus inficiunt aut foedant, licet guttae liquefactae investes incidant. Lumen etiam clarisumum, maximeque temperatum reddunt" (p. 76).

"Urbs Ping-lo (prov. Quang-si).

"In hujus urbis territorio reperitur *cera* illa *alba* ab animalculis illis insectis elaborata, de quibus supra dixi" (p. 145).

There is also an account of it in the *Nouvelle Relation de la Chine* by Gabriel de Magalhaes, published in 1668. He describes it (p. 173) as produced in the provinces of Shan-tung and Hu-kuang.

A more elaborate memoir was written by a third Jesuit missionary in China in 1752, *Mémoire sur la cire d'arbre envoyée de la province de Hou-quang, par le Père Chanseaume, de la Compagnie de Jesus*, published in the Lettres édifiantes XXIII., pp. 146–154—in which he gives an interesting account of personal observations on the habits of the insects and of the shrub, apparently a species of Ligustrum, upon which they flourished.

More recently the French Sinologue, Stanislaus Julien, has written *Nouveaux renseignements sur la cire d'arbre et sur les insectes qui la produisent, etc., extraits des auteurs Chinoises*, published in the *Comptes rendus de l'Academie des Sciences*, 1840 (pp. 618–625): and Daniel Hanbury a learned article on *The Insect White Wax of China* in the Pharmaceutical Journal XII. 1853 (p.p. 476–482).

In fact not a little has been written on the subject, and yet many of the trees on which the insect is raised have not yet been identified. The wax insect on the contrary is better known, and it has been introduced by the French into Algeria. Specimens were obtained from the neighbourhood of Ningpo by Fortune and sent to Westwood, by whom it was named *Coccus Pela*. This is a widely distributed genus, including the cochineal insect of Central America, the lac insect of China, the destructive coffee bug, and many of the pests of our own greenhouses. It has the following characteristics. The *female* has a thick, globular, wingless body, composed of 14 rings; small inconspicuous eyes; short antennæ with nine joints; a short beak, and the abdomen furnished at its extremity with two short threads. In the *male* the antennæ are long of 10 joints, the beak is absent, it has a single pair of rather large wings, and the abdominal threads are elongated. In the whole family of *Coccidæ* the females at least are always destitute of wings and remain fixed on the plants upon which they live, sucking the juice with their beaks or rostra buried in the vegetable tissue. They finally deposit their eggs without moving from the spot, and die very soon afterwards, the dried body serving to protect the eggs during the winter until they are hatched for the next year's campaign. The so called "gall" described in the reports is, therefore, the dried maternal cuticle inclosing the numerous ova. It incloses also the "beetle" or "buffalo" so graphically described by Mr. Baber, which would seem to be a parasite developed in the body of the female wax insect, ready to emerge, a fully formed insect, in the summer, serving may be, as Mr. Hosie ingeniously surmises, as a provision of nature to afford an exit for the newly hatched larvæ.

The wax insect feeds upon several different trees in China, occurring spontaneously or applied artificially to the trees, some of which are cultivated for the purpose, others wild. One of these has been named *Fraxinus Chinensis*, first described by Roxburgh in his Flora Indica (I. 148) and introduced from China into the Botanical Gardens at Calcutta prior to 1793. Fortune, in his Residence among the Chinese (p. 147), figures a small branch of this covered with the wax. He describes it as "growing abundantly on the banks of canals in the "province of Chekiang, as well as, more sparingly, in the province of "Kiangsu."

It is gathered from a shrub of the same genus in the metropolitan province of Chih-li. Dr. Bretschneider "observed the wax insect in a "wild state in the mountains west of Peking, where it lives on a species "of *Fraxinus* not yet determined. It is a shrub with small leaves, not "*Fraxinus Chinensis*, Roxb., judging from the flowers. The natives in "the mountains call it *la-shu* ('wax tree') or *sioa-k'uli* ('little k'u-li'),

" to distinguish it from the *tak'uli* (' great k'uli '), the *Fraxinus* " *bungeana*, DC., which is a tall tree with large leaves also frequent " in the same mountains." Dr. Bretschneider has sent to Paris seed of both of these species, which are now growing in the Jardin des Plantes.

Insect white wax is produced as far north even as Manchuria, according to the statistical account of the province, *Shêng-ching t'ung chih* (see Wylie's Chinese Literature, p. 36) in which, ch. xxvii. f. 37, the wax insects (*la ch'ung*) are described as of the size of lice, feeding upon the *hua chŭliu*, otherwise called *la t'iao* or wax twig tree, the small branches of which are collected and heated to extract the wax, which is noted to be somewhat yellower than the Ssŭ-ch'uan wax. This tree is doubtless also a species of ash (*Fraxinus*), it being mentioned in another part of the same book as affording strong and elastic handles for spears.

According to the *Kuang tung t'ung chih*, the statistical description of the Canton province, *pai-la* (" white wax "), is abundantly produced in the prefecture of Chiung-chou, in the tropical island of Hainan, on a tree called *ch'ing ch'ou shu*, described as an evergeeen resembling the *tung ch'ing*.

The insect is thus shown to range from Hainan in the south to Manchuria in the north, and from *Ssŭ-ch'uan* in the west to Kiang-su in the east, so that Mr. Baber is doubtless right in his conjecture that the wax may be produced in every province in China.

The *Chih wu ming shih t'ou k'ao*, the large illustrated book on Chinese Botany published in 1848, which is, I believe, in the Library attached to the Kew Herbarium, figures four insect wax-producing trees, giving a short description of each, which I will translate.

I. The Nü chên (Ch. xxiii. f. 23).

The Nü chên (Virgin tree) was included in the Pên ching (the most ancient book on materia medica) in the first class of drugs. It is now always commonly called Tung ch'ing (evergreen tree). Li Shih-chên says that the Nü chên has dark purple fruit, while the Tung-ch'ing has red fruit, and he is perfectly right. In the province of Hu-nan it is always called la shu (" wax tree ") and they gain much profit from the cultivation of wax upon it. There is also a hsias la shu (" small wax tree "), the branches, leaves, flowers, and fruit all similar, but the height not exceeding four or five feet. The Chui-huang pên ts'ao (a treatise on plants fit for supporting life in times of scarcity) gives Tung-ch'ing leaf-buds and leaves as eatable, pointing to this tree.

II. The Tung ch'ing (Ch. xxxv. f. 51).

The Tung-ch'ing (evergreen tree) is described in the Sung T'ose ching (an illustrated materia medica in 21 books, published by Imperial order in the 11th century) under Nü chên. The Pên ts'ao hang mu (the celebrated materia medica by Li Shih-chên) first distinguished it by its leaves being a little rounder and its fruit of red colour. It is commonly used to graft the *Olea fragrans* upon. Wax can also be produced upon it.

III. The La shu (Ch. xxxvi. f. 49).

The La shu (wax tree) is planted in the province of Kuei-chou at Kuei ting Hsien in groves, for the profitable cultivation of wax. They lop off the branches in place of which a mass of twigs sprout out which are again cut off, to grow thicker than ever. The trees line the

two sides of the way like the rows of willows on the Government roads. The leaves are somewhat round, in the autumn it produces small pods, like those of the Ch'un (*Ailantus glandulosa*) but thinner and smaller, which hang down in the midst of the leaves. The Kuei hsin tsa chih (written by Chou Mi in the 14th century, v. Wylie l.c. p. 158), describing the method of cultivation of wax by tying pots to trees, the leaves of which are like the leaves of the Chu yü (*Boymia* [Evodia] *rutæcarpa?*), perhaps refers to this tree.

IV. Hsiao la shu (Ch. xxxvii. f. 18).

The Hsiao la shu ("small wax tree") abounds in the mountains and hills of the province of Hu-nan. It is five or six feet high. The branches, leaves, and flowers all resemble those of the Nü chên but are smaller, and it produces small dark coloured fruit in great profusion. In Hu-nan two kinds of trees* are used for the production of wax, the yu la (lit. "fish wax") and the shui la ("water wax"). The Yu la tree is small and the leaves slender, the Shui la tree is tall with large thick leaves. The latter is the Nü chên, the former the plant here figured. Some call it the water tung ch'ing, the leaves being delicate and soft not very unlike those of the Tung ch'ing, also used for the cultivation of wax, but these are arbitrary distinctions based on the differences between cultivated and wild trees. The water tung ch'ing referred to in "Sung's Miscellanies" as having slender leaves and being profitable for raising wax insects is this tree. Li Shih ch'ên says there is a water wax tree with leaves like those of the elm on which insects can also be raised for the production of wax, which must be a different species.

In the descriptive portion (chang pien) of the same book, as an appendix to the account of the Nü chên tree, there is a special article compiled from older authers—On the Production of Wax (Ch. xix. f. 60, 63).

Wang chi, in the Pên ts'ao hui pien (a Materia Medica in 20 books of the reign of Chia-ching (1522–67)), says:—"White insect wax is "different from the white sort of beeswax and is made by small insects. "These insects feed upon the sap of the tunch'ing tree, and after a long "time change into white fat, which adheres to the twigs of the tree. It "is said by some to be only the excrement of the insects sticking to the "tree, but this is wrong. In autumn this is scraped off and collected, "melted with boiling water, and then poured into cold water, when it "solidifies into a hard mass which when broken exhibits markings like "gypsum but is more transparent. It is mixed with fat to make candles, "which are much superior to those of beeswax."

Sung, in his Miscellanies, says:—"The seeds of the Tung ch'ing can be "planted or used for flavouring wine when the tree is full grown, the "eggs of the insect are hatched upon it in the fifth month and the wax "collected in the seventh month. It must not be entirely taken, but some "left till the following year, so that living eggs may be again taken in "the fourth month for the new crop. Having been dried in the sun, "and a cotton cloth tied over the mouth of an earthern steamer, the "wax is placed thereupon. A vessel is placed inside the steamer, and "when the water in the pan boils the wax flows down into the vessel. "It solidifies into a hard white substance used for the manufacture of "candles. The dregs are put into a silk bag which is placed in hot "oil. The wax is all extracted, and the wax can be at once made into

*. Cf. The Memoir of Père Chanseaume cited above.

" candles. When trees have been employed three years to feed the wax " insect they must rest for three years."

He says again :—" In the province of Ssŭ-chu'an, when the seeds are " sown they are first steeped for ten days in water in which rice has " been washed, then pounded to remove the shell. During the produc- " tion of the wax all the undergrowth near the trees must be carefully " removed. Before the insects can be again raised the tree must rest one " year. When the wax is collected the wood must be all cut off and no " old branches left."

In the Nung ch'êng ch'üan shu (the celebrated Thesaurus of Agriculture compiled by Hsü kuang-ch'i, A.D. 1562–1633, a native of Shanghai, the learned patron of the early Jesuit missionaries in China often mentioned in Du Halde's Description as Paul Siu, Coloa, Premier Ministre d'Etat, his portrait being also given there: which Thesaurus was published by imperial command after his death, in 1640, in sixty books, illustrated by many woodcuts, Wylie, l.c. p. 76) we find :—

" There are two kinds of wax collected from the Nüchên tree, the one growing spontaneously, the other after the application of eggs. when it grows spontaneously it is not known whence the insects come, but all at once the tree is covered with a growth of white 'flowers,' the wax produced upon the branches like hoar frost or snow is known by the natives as 'flowers,' which is gathered and boiled into wax; next year the insect eggs are again hatched; and so on afterwards in continuous annual generation. If the method of raising the insects be unknown the tree is soon killed, whereas if the eggs are collected and applied, the process may be continued indefinitely. When the eggs are applied they are brought from another tree and put upon this tree. The process may be repeated either each year or in alternate years, either on the same tree or upon cuttings. Should the tree be very vigorous the insects may be put upon it every year; should it be weak and worn out it must be allowed to rest a year to regain its strength, being manured till it recovers its growth, when the insects can be once more put upon it. This is what Sung refers to when he says 'Cultivate one year, rest one year.' For cuttings, remove branches from the tree of over an inch in diameter and plant them, and when these have grown strongly put the insects on to produce wax. All the branches within three or four feet of the root must be cut off. After the wax has been collected manure must be applied at intervals and again during the winter. During the following year new branches growing out of the sides must be cut off as they appear, and the tree trimmed to make it grow up straight. The next year it must be again trimmed and constantly manured. The third year the wax insects may be raised upon it. On the fourth year again, and yet again on the fifth. After the collection of the wax the tree must again be trimmed, and so on in continuous succession. This is called 'After three years rest three years.' "

The insect eggs must all be put upon the tree during the first three days of summer (May 5–7), the adjoining branches having been cut off, leaving only an inch or so, in order that the insects may fix upon the wood. When the branches have been trimmed they are tied on in bunches of three or four up to ten " galls," or even singly. Rice is steeped in water for about half a day. The water is then poured off and the insect " galls," having been peeled, are soaked in the water for about a quarter of an hour. They are taken out and lightly wrapped in bamboo leaves, three or four large, six or seven small, " galls " in each bundle, tied up with grass and put into a clean earthen jar. If it be cloudy or rainy the " galls " may be left in this jar for some days, but

if the weather be hot many of the insects would escape, and they must be put on at once.

When about to put on, the four corners of the little bundles must be cut off, so as to leave holes as large as small beans. They are then tied with grass upon the branches of the tree, in greater or less numbers, according to the size of the branches. They must be tied on branches about the size of the finger, not upon the smaller twigs nor upon the large branches. For some days after they have been tied on the birds will come pecking at the bundles to get at the eggs, and they must be carefully driven away. As the weather becomes warmer the insects begin to emerge from the bundles. At first they run up and down the tree, and if there be weeds at the foot of the tree many will be lost in the undergrowth instead of climbing, therefore the ground must be kept perfectly clear. Next they travel to the under surface of the leaves and fix themselves there. Some days later they remove to the branches and twigs, burying their beaks in the bark and sucking nourishment from the juices of the tree. Thus do they made the "flowers." When it is calculated that all have come out, the bundles are taken down and examined to see if any eggs are left, and if there are they are made into a new bundle and put on another tree.

In the beginning of October the "flowers" must be examined, for if left too long no wax will be obtained, nor will it be if they are not ripe; if too old it will be impossible to strip them off. When the time comes the tree may be stripped as it stands, or the branches may be cut off first. In both cases water must first be sprinkled on so that they may be easily peeled. If it be rainy or at early dawn while the dew still remains still better. After the wax "flowers" have been collected they are thrown into boiling water. The melted wax rises to the surface, and when cool is removed. The water is again boiled and more wax obtained. The dregs at the bottom of the boiler are taken out with a ladle. Should the wax not be clean it must be boiled again in the same way. When perfectly pure and still fluid a loop of string is let down into it, by which, when cold, it is drawn up as a solid cake of wax.

Immersing in this way the insect eggs in water, in which rice has been steeped, peeling them and wrapping them in leaves is the practice at Wu-chou (now Chin-hua Fu, in the province of Che-kiang). In Wu-hsing (now Hu-chou Fu, in the same province) the natives wait till the middle of May before they cut off the eggs, which they wrap up in bundles and hang upon the branches of the old trees to produce a new crop of wax. At Tsui-li (now Chia-hsing Fu) and in my own district the eggs appear spontaneously and produce wax, it not being necessary to bring them from other trees. It is evident that in the succeeding generations natural growth is the essential thing, and in my native country they say that with their own eggs, without regard to days of the month, they only wait till they have attained their full growth and are ready to be hatched, when they cut off the "galls" and put them on the branches.

It is the common method to remove the eggs in the beginning of May, and to the east of the province of Che-kiang, where the climate is hot and they bring their eggs from other parts, they are afraid of the insects being hatched and lost, and consequently fix this date. But Wu-hsing being north, and my own district still farther north than Wu-hsing, the natives of my country who go to Wu-hsing and to the east to buy eggs must cut off the eggs ten days later, so as to put them on towards the end of May. Those who come from the east to my district to buy eggs

must, on the other hand, cut off the eggs before May. To the north of my country, where it is still colder, the insects must be put on even later.

When the insect eggs are not produced in the country they must be bought in other places, distant sometimes 1,000 *li*. Thus in the province of Che-Kiang, at Chin-hua Fu, where this industry is most flourishing, they buy the eggs in the prefecture of Shao-hsing, T'ai-chou, and Hu-chou. In the province of Ssŭ-ch'uan it flourishes most in Hsi-chung Hsien and in Chia-ting Fu, and they buy the eggs in T'ung-chuan Fu. The distance in all these cases amounts to several hundred *li*. The eggs of the wax insect are mature before May, and they may be suspended on the new trees some time before they are hatched. They must be conveyed with all possible speed, otherwise the insects will escape before they can be put upon the trees, to the great loss of the purchasers. Hence the common saying, "Swift horses for buying the wax insects." If they are wrapped in leaves in the way described above, and put into earthen jars, the insects, even if they are hatched, remain in the bundles, and a delay of two or three days before they are put on the trees is of no consequence.

From Chin-hua they go every year to Hu-chou, and from Chia-ting to Tung-ch'uan, to buy eggs, the eggs not being produced in their own country. When asked why, they reply, "Because Chin-hua and Chia-ting produce the 'flowers' only, not eggs." But at Chin-hua native eggs also occur, although their value is one-half less. At Chia-ting no eggs are produced, and the eggs brought there are 10 times dearer than their original cost at Tung-ch'uan. The reason of this is not clear. I have often thought over it, and it seems that a young tree will produce principally "flowers," an old tree principally eggs, a short tree many "flowers," a tall one many eggs. If many eggs are put on one tree it will produce principally "flowers," if only a few eggs principally eggs. Again, when brought from the north and cultivated in the south many flowers will be obtained, when brought from the south to the north mostly eggs. Thus the eggs brought from Hu-chou to Chin-hua produce only flowers, and those taken from Chin-hua to the province of Fuh-kien also produce "flowers" only; consequently at Chin-hua most of the eggs are sent to the province of Fuh-kien, while they send to buy others from Wu-hsing. If taken from Chin-hua to Hu-chou they would produce mostly eggs. So also when the eggs are brought from Tung-ch'uan to Chia-ting they produce "flowers" only, while Chia-ting eggs taken to Tung-ch'uan will produce mostly eggs, Tung-ch'uan being north of Chia-ting. The "flowers" are naturally fond of heat, the eggs prefer cold. The different productions of old and young, of tall and short, of northern and southern trees, depend on a similar cause.

Some say that the trees which produce "flowers" do not produce seeds, and that those which produce seeds do not produce "flowers." This may be sometimes the case, but it is not always so. Generally both "flowers" and eggs are produced together, and when desirous of saving the eggs one must not collect the "flowers" too early. Nothing can be seen of them till the following spring, when they appear scattered on the smaller branches of the tree as shell-like tubercles, which are full grown at the approach of summer. Thus the "flowers" and eggs are not seen together. The eggs, when full grown, have inside fatty matter of the consistence of honey, and if this come out they will be dried up and destroyed.

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Report on the Production of Insect or White Wax in the Province of Anhui.

In compliance with instructions received from Earl Granville, conveyed to me in a despatch from Mr. Philip W. Currie, dated February 1st, 1884, I instituted inquiries relating to the production of insect or white wax in this district, and in the province of Anhui generally.

For some time my inquiries led only to directly negative results, and to show the difficulty I experienced in obtaining information on the subject, I may mention that I was at the outset assured, not only by the dealers in white wax in Wuhu, but by the Fastai, the chief local authority here (who was good enough to refer to official publications in his possession), that no white wax was produced in Anhui, nor in any other province of the empire besides Ssŭ-chuan. The dealers also scouted the idea that white wax was produced elsewhere, and it seemed that I should only be able to report that in this province no production took place.

While, however, making these inquiries, I obtained the loan of Father Rathouis' monogragh on the insect, and after its persual, as a last resort wrote to Father Seckinger, the head of the Jesuit Mission at Nganking, and it is from him and through him that I am indebted for such meagre information and specimens as I am able to supply; and I wish at once to acknowledge the obligation I am under to him for his kind interest in the matter.

The specimens of the wax insect examined and described by Father Rathouis, were supplied to him by Father Seckinger from the grounds of the Jesuit Mission at Nganking. Father Seckinger observed the white deposit on the branches of a shrub called the Tung ch'ing tree, which I have reason to believe is the common large-leaved privet, and after examination came to the conclusion that the deposit was made by the wax insect, and forwarded specimens to Father Rathouis for examination. The insect was undoubtedly produced spontaneously in this garden at Nganking, that is, no intentional transference of the insect had taken place. At the time of the discovery it was supposed that no insects existed, or at any rate no wax was cultivated nearer than the district of Pochou in the extreme north-west corner of Anhui, about 300 or 350 miles from Nganking. I have since discovered that this industry is carried on on a small scale in the neighbourhood of the district city of T'ung-ch'êng, some 80 miles from Nganking and 200 miles from Wuhu. The wax produced is consumed locally, and the production is comparatively trifling. The specimens forwarded direct to Kew Gardens were obtained near T'ung-ch'êng.

Pochou is the Anhui centre of a very considerable trade in white wax. The district throughout which it is produced is very large, and extends from Pochou into the provinces of Honan, Shantung, and Kiang-su. The quantity of wax produced in Anhui is small as compared with the production of the other provinces named. I cannot obtain any information as to the whole area of production, but it is undoubtedly very extensive; nor could I, without visiting Pochou, hope to gain any approximate estimate as to the total quantity produced annually. There is no communication except by land between Pochou and Nganking, and a journey of so extensive a nature is quite out of the question. A visit to Pochou and the neighbouring districts could not be accomplished with any useful result in less than two months, the expense would be very considerable, and even on the spot accurate information as to the quantities produced would be extremely difficult to obtain.

The wax produced near Pochou finds its way to market to the northward, and a considerable quantity also reaches Shanghai by the Grand Canal and other waterways. None of it comes to Nganking or Wuhu which fact no doubt accounts for the profound ignorance existing in Wuhu on the subject.

The quantity of the wax produced near Pochou is said to be quite equal to that of Ssŭ-chuan; there appears at any rate to be no such marked difference as to make it noticeable either one way or the other. I cannot learn when the industry was first introduced into Pochou, or that at any time insects were transferred from Ssŭ-chuan to Anhui. I am much inclined to think that it is indigenous, and its spontaneous appearance in the garden of the Jesuit Mission at Nganking tends to confirm this opinion. The insect is said to be identical with that of Ssŭ-chuan, or rather, as in the case of the wax, no difference is commonly known to exist. With such minute insects even specific differences would be invisible to unscientific eyes, and to the Chinese, so long as there was no startling divergence in the colour or quality of the habitat or size of the insect, it would be the same; most probably it would be so reckoned even if it differed essentially in all those particulars.

In Anhui, as in Ssŭ-chuan, the practice of transferring the eggs of the insect from one tree to another is customary. I have not been able to obtain any explanation of the reason for this from my informant. The following, which I suggested to him, he agreed to as probable and adequate.

The natural habitat of the wax insect would appear to be the Tung-ch'ing tree, a species I believe, as I have already stated, of large-leaved privet. This tree is little more than a shrub, and, like most evergreens, is of slow growth. If left to themselves, the insects would continue to live and produce wax on this tree, and probably when the value of the wax first became known, and the industry became established, this was the case, but gradually it was found that the collection of the wax on the scale and with the speed required for commercial purposes, necessitated the partial or total destruction of the trees on which it was spontaneously produced. It therefore became necessary to discover some quick growing tree of suitable habits to which the eggs could be transferred, and the subsequent operations completed. This tree was by accident, or actual experiment, discovered in the "*Fraxinus chinensis*," as it is called in Father Rathouis' monograph. It grows rapidly from slips, and in two or three years attains a height of 8 or 10 feet with a circumference of 7 or 8 inches. The Chinese call the tree the white wax tree (Pai-la Shu), and apparently know it by no other name. It is of a straight habit of growth, and when cut down is of considerable value, chiefly, it appears, for spear shafts and pike handles; so much is this the case that to raise a body of troops in or near the white wax district is called "levying five hundred or a thousand white wax staves." As I am assured by my informant that this is a common form of expression in that district, I think that we may conclude that the industry is widely extended, and that it has existed for a lengthened period.

The Chinese do not appear to attribute any property to the Pai-la tree tending to stimulate the secretion of wax. The whole country round Pochou is a dry level plain, no rice is cultivated, the plain is, however, fertile. The Tung-ch'ing tree and the Pai-la tree grow side by side, no difference whatever is said to exist in the situation in which they flourish, and the wax is collected and the insect bred on the same patch of ground. I am inclined to think that at Pochou the privet is not altogether essential to the production of the insect. It seems that

when the wax has been secreted on the Pai-la tree, a selection of a sufficient number of the most thickly coated of the twigs and smaller branches is made, and that from these the next year's crop is raised.

The Pai-la tree is systematically cultivated from cuttings. Large nurseries are formed, and the young trees are planted out when they have attained a sufficient growth. They are sometimes formed into plantations of considerable extent, but I gather that for the most part they are grown round the fields, and that every small farmer of the district is engaged in a greater or less degree in the industry. The trees attain a suitable size in about three years. The eggs of the wax insect are then placed on them, and in due course, about the month of September, the wax has been deposited and is ready for boiling. The trees are then cut down, the branches are lopped, and the bark stripped from the main stem; the poles are then, as has been stated, used for various purposes.

Before the trees are cut down, a sufficiency of the most thickly coated branches are removed, and put in baskets which are placed in a warm airy room. As the weather gets cooler the room is very slightly heated. In the month of December the cocoons, which apparently by this time have been formed, are removed. They are placed in small boxes filled with cotton wool, and are kept during the winter in moderately warm rooms, from which all draughts are carefully excluded. In very cold weather the boxes are placed on slightly heated stoves. The precautions necessary for their preservation were described to me as being very similar to those for the conservation of silk worm eggs.

About the end of March, when the young insects are nearly ready to leave the cocoons, baskets about a foot long and seven inches wide are fastened round the stem of each of the Pai-la trees. In these baskets the cotton wool containing the cocoons is placed, and shortly afterwards the minute insects come out and spread themselves over the trees. I have been quite unable to ascertain whether the wax insect is subject to the attacks of other insects called the "La-mu" or "La-kou," but such probably is the case.

The wax is obtained by boiling the leaves, branches, and the bark of the Pai-la trees in iron pans. This operation is repeated several times until all the wax has been obtained. The wax itself is also subjected to repeated boiling for the purpose of removing all impurities. It is then finally poured into earthenware bowls and allowed to cool. Ssŭ-ch'uan wax as seen in the market here is made up into large discs about 5 inches thick and some 20 inches in diameter, weighing between 50 and 60 pounds. The average price of this wax in Wuhu is about 3*s.* a pound, and I cannot learn that of late years there has been any serious fluctuations in the production or the cost. The small quantities of Anhui wax (bought at T'ung-ch'êng) that I have as yet been able to obtain has evidently been cooled in much smaller quantities than that from Ssŭ-ch'uan. It is possible that after the wax has passed from the hands of the retail producer into those of the wholesale dealer it is run into larger moulds for the market. I cannot learn that any substance is added to the wax in the course of manufacture; it professes to be pure; that it is not adulterated is scarcely possible, unless indeed it has been found impossible to mix any extraneous substance with it without instant detection.

The uses to which the wax is applied are three in number. It is used primarily to coat candles made of vegetable* tallow with rush wicks. Candles manufactured for imperial use are said to be made entirely of wax. Its second use is to coat pills and boluses, simply to preserve the

* And animal tallow.

drugs ; the wax is not swallowed. Thirdly it is largely used whenever it is desired to put a gloss on articles of almost every description. The operation is always performed in the same way. The article to be glossed, be it fine paper, cotton fabrics, pictures, or the sides of the thick white soles of Chinese shoes, is first rubbed with a small quantity of the wax, and is then polished with a smooth stone rubber. I have been repeatedly informed, in reply to my inquiries, that this wax is never used to put a gloss on silk fabrics. I cannot of course vouch for the accuracy of this statement.

I must in conclusion add a word of apology for the meagreness of this report, which I hope on a future occasion to supplement, and for the incompleteness of the information at second and third hand with which I have been compelled to content myself. It has not, however, been possible for me to visit even T'ung ch'êng during the past summer. An expedition of the kind to be of much use would have necessitated an absence from my post that would not have been convenient at the present juncture. To obtain the specimens of the T'ung-ch'ing and Pai-la trees, the twigs coated with wax, the small specimen of the wax itself, manufactured on the spot, accompanying this report, I was obliged to avail myself of the services of a Chinese furnished me by Father Seckinger. The dried specimens are, I am afraid, not satisfactory in themselves or at all skilfully dried, but I trust they will prove sufficient to determine accurately the nature of the two trees. The wax coated candles were bought in Wuhu, and are coated with Ssŭ-chuan wax.

(Signed) B. C. George Scott,
Consul.

Her Britannic Majesty's Consulate,
Wuhu, October 23rd, 1884.

CCCIII.—MISCELLANEOUS NOTES.

Mr. William Granger, Office-keeper and Store-keeper at the Royal Gardens, retired on the 30th April last, after forty-three years service. Mr. Granger was highly respected and esteemed by the whole staff at Kew, and his sympathetic disposition and high sense of duty had endeared him to a long succession of young gardeners, and materially helped to maintain a manly and self-respecting tone amongst them. In recognition of Mr. Granger's long and faithful service the Lords Commissioners of H.M.'s Treasury have granted him a retiring pension.

Mr. George Dear, a seed collector, in the employ of the Royal Gardens, has been appointed Time-keeper and Store-keeper in succession to Mr. William Granger.

Senecio sagittifolius.—Kew is indebted to Mons. E. André for a young plant of this remarkable *Senecio* which he discovered in Montevideo, and introduced into France in 1890. It forms a rosette of large leaves each over a yard in length and a foot in width, sagittate with laciniated edges, and a raised frill like midrib. The stem rises erect from the centre of the rosette to a height of six or eight feet ; it is clothed with

lanceolate erect leaves and bears at the apex an enormous corymb of daisy-like flowers, each over an inch in diameter and white with a yellow disc. In the garden of Mons. Lacroix in Touraine, a specimen of this *Senecio* in the open air last summer grew to a large size, and on being removed to a greenhouse for the winter, it developed a flower stem over six feet high and a corymb of 140 flowers. The Kew specimen flowered in March, and a figure of it has been prepared for publication in the *Botanical Magazine*.

Plants from the Shiré Highlands.—A small collection of living ferns and bulbous plants was recently received at Kew from Mr. John Moir, of Mandala, near Blantyre, in East Tropical Africa. They were packed in a small box and were entrusted to Miss Florence E. Turner, who took care of them during the voyage. Although they had been in the box from November to February, and had been at sea about a month, yet almost every one of the plants was alive on arrival. The fact that almost all kinds of living plants may be sent long distances in wooden boxes with ordinary care, and that seeds may be despatched in an ordinary canvas bag by post, without appreciable suffering, should lead to the introduction of many new and interesting plants from remote parts of Africa, from New Guinea, and other places in course of being opened by European enterprise.

Australian Alpine Plants.—In a communication to *The Garden* last year (Vol. xlii. p. 153), Mr. A. R. Wallace drew attention to the alpine and sub-alpine plants of Australia, and suggested that many of them would prove hardy in this country. It is remarkable that among the hosts of plants introduced into England from Australia in the early part of this century not one has hitherto proved hardy, but as Mr. Wallace said, "probably no attempt has ever been made to obtain "plants from the cold uplands for cultivation in this country." Acting on this hint, a copy of Mr. Wallace's paper was forwarded to Sir F. von Mueller in Melbourne, to whom we are indebted for a very large proportion of the living representatives of the Australian flora now at Kew, and whose zeal is shown by the following letter which accompanied a box containing two plants, both likely to live. He wrote "I had induced my assistant to ascend during these holidays Mount "Baw Baw (in Victoria), first scaled by me in 1860, and the only place, "except one other mount close by, where the sub-alpine *Wittsteinia* "*vaccineacea* grows. He has just brought living plants; so I send some "few at once to you, and along with it *Coprosma pumila*, trusting that "they will endure in the cigar case, packed in moist moss, the few weeks' "journey to you. The plant is sub-alpine and would require cold-house "treatment with you. . . . . I have sent berries repeatedly, but "the seeds seem never to have germinated. So far as I know the plant "is new to European culture. As a wondrous rarity it is a counterpart to "*Orphanidesia*." *Wittsteinia* is a monotypic genus of *Ericaceæ*, with prostrate creeping stems and ascending branches a foot long, clothed with small thick roundish toothed leaves and solitary axillary flowers, with a small yellowish-green or reddish campanulate corolla $\frac{1}{2}$ inch long. The fruit is a globular berry coloured like the flowers. It grows in the crevices of rocks and on rocky summits of the Baw Baw Mountains, and also in the Albert Range and sources of the Yarra, at an elevation of 3,500 to 5,000 feet. This plant, along with a single species

of *Pernettya*, and three species of *Gaultheria*, form the only Australian representatives of the large order *Ericaceæ*. *Coprosma pumila*, Hook. f., is described as a prostrate densely-matted glabrous shrub, creeping and rooting sometimes to a great extent, with small ovate shining leaves and solitary terminal flowers $\frac{1}{4}$-inch long. It grows on snowy mossy plains on the Baw Baw and other of the Australian Alps, at an elevation of 4,000 to 6,000 feet. It is also a native of Tasmania and New Zealand. There are four other species of *Coprosma* in Australia, none of which is known to be in cultivation here. It is to be hoped that others beside Sir F. von Mueller will take up Mr. Wallace's suggestion, as the behaviour of the alpine plants of Australia under the very different conditions of out-door gardening here would be interesting to botanists as well as to horticulturists.

Dischidia rafflesiana, Wall.—Miss E. Sargant, working in the Jodrell Laboratory, has made a thorough investigation of the structure and development of the ascidia of *Dischidia rafflesiana* (see *Kew Bulletin*, 1892, p. 284), with the following results :—

The structure of the pitcher of *D. rafflesiana* is, in essentials, that of the leaf. The similarity is most striking in the younger stages of development of the pitcher, when its mesophyll is of uniform structure throughout, and resembles that of the mature leaf. The orientation of the usually bicollateral vascular bundles is such that their protoxylem is always directed towards the upper surface of the leaf, and the outer surface of the pitcher. This confirms Dr. Treub's view, based on the history of development of the pitcher, that its outer surface corresponds to the superior surface of the normal leaf. Certain structural differences which exist between the mature pitcher and the leaf are interesting in their bearing on the question of the function of the pitcher. There is nothing to suggest a carnivorous habit, as no secreting glands comparable with those of *Nepenthes* and other insectivorous pitcher-plants are to be found. The "processes" described by Dr. Treub are undoubtedly glandular organs, secreting mucilage and probably resin also, but they cease to be functional long before the pitcher is mature. These processes are common to the young pitcher and the young leaf. They occur at the base of the petiole, and on the superior surface of the lamina near its base, and a gland is also present at the apex of the lamina. The glandular and woolly hairs found on the young leaf and pitcher are also transitory structures, having no relation to the functions of the mature organ. In the normal leaf the stomata are about equally numerous on both surfaces (25 or 26 per square inch on each). In the pitcher there is a marked difference; the inner surface has on the average 33 stomata per square inch, the outer has only 16. In the mature pitcher some of the outer stomata are closed by formation of periderm. There is more differentiation in the mesophyll of the mature pitcher than in that of the leaf. The cells near the outer surface in the former are of the same rounded form as those of the leaf, but more closely packed, and richer in chlorophyll. The cells towards the inner surface of the pitcher are irregularly branched, with numerous intercellular spaces, and, in fact, form a spongy parenchyma.

Dr. Treub has already remarked on the accumulation of detritus in the pitchers. It partly covers the roots, which are pressed against the inner surface. The rootlets are often flattened, and develop root-hairs

more freely on one side, showing a tendency to become dorsiventral. This peculiarity, however, is not confined to the pitcher-roots. In the roots of *D. bengalensis*, a species which is destitute of pitchers, a still more marked dorsiventral structure was observed. The root-hairs adhere firmly to the particles of the humus contained in the pitchers. The roots, both those in the pitchers and those external to them, show several anatomical peculiarities described. These are published in the full account of the investigation in the *Annals of Botany* (1893, p. 243). The observations made all go to support the view that these ascidia serve as reservoirs both for water and for vegetable detritus, from which the roots derive nourishment. They also serve to condense, and thus to economise, the aqueous vapour given off in transpiration. Both as regards the morphology and physiology of these organs, the results of this investigation are confirmatory of those arrived at by Dr. Treub.

A Drift-seed from Swansea Bay.—Dr. A. Lloydd-Jones lately sent a seed of *Entada scandens* for determination. It was said to be exactly like one picked up in Swansea Bay, and supposed to have been conveyed thither by the Gulf stream. In all probability this is the correct explanation of its presence there, but of course a large handsome seed such as this is often brought away from the tropics by travellers. Two hundred years ago Sloane recorded (*Philosophical Transactions of the Royal Society of London*, 1696, xix. p. 298) the fact that this seed and three other West Indian seeds were commonly cast ashore in the Orkneys. And Linnæus (*Amœnitates Academicæ*, viii. p. 3), mentions this among other seeds thrown up on the Norwegian coast. Some few years ago, too, several plants of *Entada scandens* were raised at Kew from seeds cast up in the Azores. There is little doubt that in all these instances the seeds had drifted from tropical America obliquely across the Atlantic. But the most interesting point is that after floating for weeks, and may be months, in sea-water they retain their germinating power.